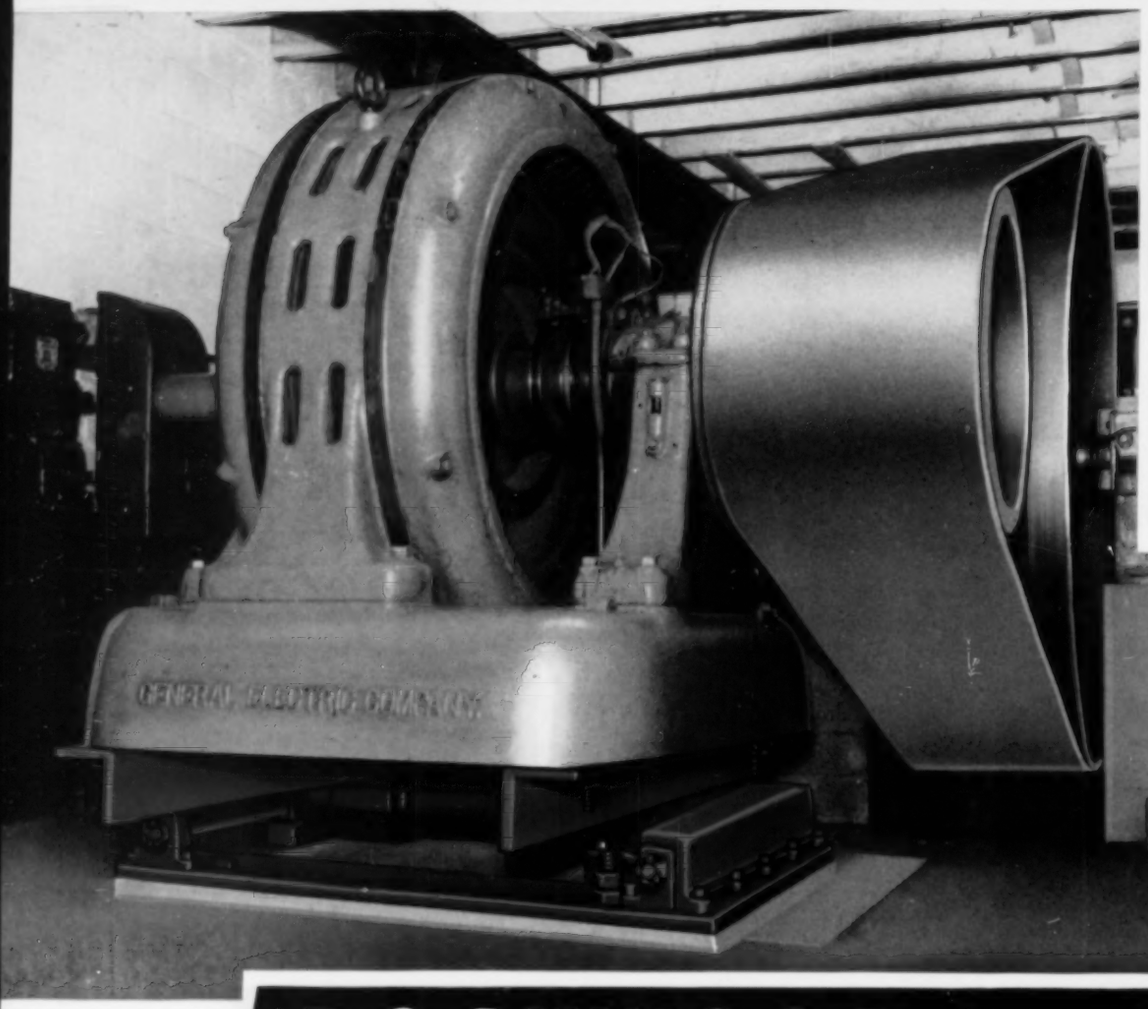
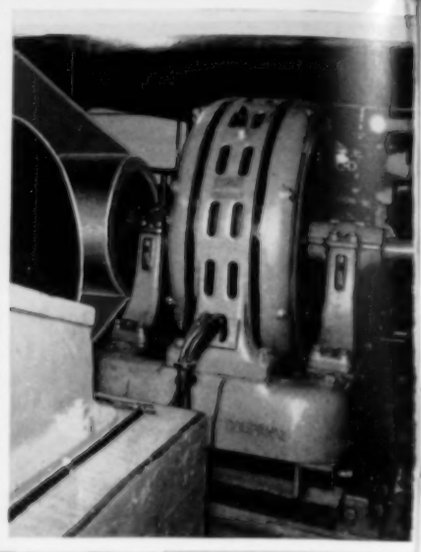
Compressed Air Magazine

VOLUME 47 · NUMBER 11 NOVEMBER 1942 LONDON · NEW YORK · PARIS

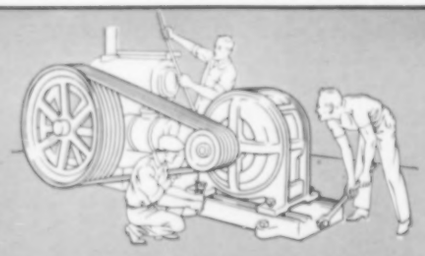
COMPRESSED AIR GEYSER





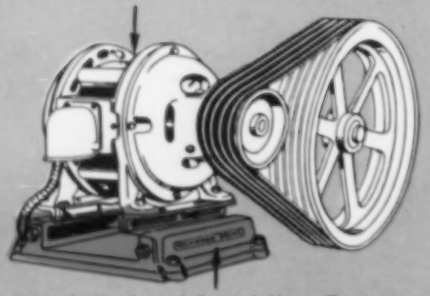
Increased compressor outputs of 10% to 15% are common for Rockwood Drive installations—OR you can save on your power bill and through increased life of your drive belts.

ROCKWOOD *automatic belt tightening* MOTOR BASES



YOU DO NOT HAVE TO DO THIS

Moving the motor back manually to "take up" the belt or set of belts has always been a headache and the benefits are too temporary. You have to keep doing it and any overtightness of the belts wears out the belts that much faster.



With the Rockwood Pivoted Motor Base your belt or belts—Vee or flat—are automatically tightened—or slackened off again WITH EACH AND EVERY CHANGE IN LOAD.

INCREASE COMPRESSOR CAPACITIES — SAVE POWER — SAVE BELT WEAR.

It is hard to realize that a so simple, inexpensive and easy-to-make change in the mountings of the motors of your belted compressors will make so big a difference. YET THOUSANDS OF COMPRESSOR USERS HAVE MADE THE CHANGE AND FOUND THAT THEY HAVE INCREASED CAPACITIES AS MUCH AS 10 TO 15%.

All you have to do is to replace your old fashioned, fixed center motor slide rails with Rockwood **automatic-belt-tightening motor** bases. The change costs little and takes but a few hours to make. YET IT DEFINITELY ASSURES MORE COMPRESSOR OUTPUT. And, at the same time, it eliminates maintenance and practically doubles the life of the belts.

MODERNIZE YOUR COMPRESSORS NOW—BRING THEM UP TO DATE—IMPROVE THEIR PERFORMANCE—SAVE ON BELTS AND POWER. Rockwood bases are available for immediate delivery from stock.

ROCKWOOD MANUFACTURING COMPANY

Indianapolis, Indiana

ROCKWOOD V-BELTS AND V-SHEAVES

ROCKWOOD PIVOTED MOTOR BASES

ROCKWOOD PAPER PULLEYS

"CHIEF, IT LOOKS AS THOUGH WE WON'T BE ABLE TO GET THAT NEW EQUIPMENT"
"THEN LET'S PLAN FOR MORE STAYNEW FILTERS TO KEEP OUR PRESENT EQUIPMENT AT PEAK EFFICIENCY"

Check Your Needs Now FOR STAYNEW FILTERS

Not only are many suppliers unable to deliver new equipment, but nowadays competent repair service is often unavailable. Present equipment must be made to last. One of the best ways to assure its continuous, repair-free operation is to protect it with Staynew Filters.

Staynew builds filters for your compressor and engine protection, pipe lines, building ventilation, air, gas, and liquids. Sizes and styles are made for nearly every requirement. If necessary, Staynew engineers will adapt present models or design new ones for your special needs. "Keep 'Em New" with Staynew Filters.

Write for catalog today, and find out how your equipment can be made to last longer and operate more efficiently when Staynew Filter-protected.

Representatives in Principal Cities

STAYNEW FILTER CORP.

"Filter Headquarters"

PROTECTOMOTOR AIR FILTERS

7 Centre Park, Rochester, N. Y.

COMPRESSOR INTAKE

Model D

Air drawn into intakes of Diesels and other internal combustion engines and compressors must be clean. Dust scores cylinder walls, causes valves to stick and burn, forms excessive carbon, wears all moving parts. Model D Filters featuring famous radial fin construction are the most efficient ever designed for intake use. No damage to engine or compressor due to intake of foreign matter can result even though the Model D Filter is improperly serviced. Being dry-type Model D's are particularly adapted for use with carbon ring compressors They are not affected by atmospheric changes of temperature or humidity.

PIPE LINE

Model CPHS

Dust, dirt, moisture, and pipe scale in air and gas lines cause damage to air-powered tools and to many processes. Foreign matter in liquid lines (for oil, water, acid, etc.) may cause excessive wear, prevent proper reactions. Models CP, CPH, CPHS, CPHLS, and AAPHS guard innumerable machines and operations. Featured radial fin construction permits high filtering efficiency, low restriction to flow.

BUILDING AND ENGINE ROOM VENTILATION.

Automatic

Employee health, as well as the proper operation and protection of much vital equipment, depend on clean air. Motors, transformers, turbo generators, etc., must be supplied with dust-free air. Staynew Automatic Filters deliver large volumes of clean air at low cost.

Panel Filters (below, left) offer highest possible efficiency with low restriction to air flow. Wire-Klad Filters (below, right) feature low initial cost, long life and fire resistance.

PANEL

Intake Side

WIRE-KLAD

Outlet Side

DAYTONS STAND GUARD

OVER 100,000 OF AMERICA'S INDUSTRIAL FRONTS

On more than 100,000 vital industrial fronts Dayton V-Belts vigilantly guard the output of every conceivable type of machinery essential to America's global war. And on this nation-wide production front, Daytons are pledged and proved to save precious time and protect machinery which is invaluable to our war effort.

Cool running, long life Dayton V-Belts have the strength, flexibility and gripping power to assure closer speed control—cut power losses and reduce maintenance and adjustments to a negligible minimum.

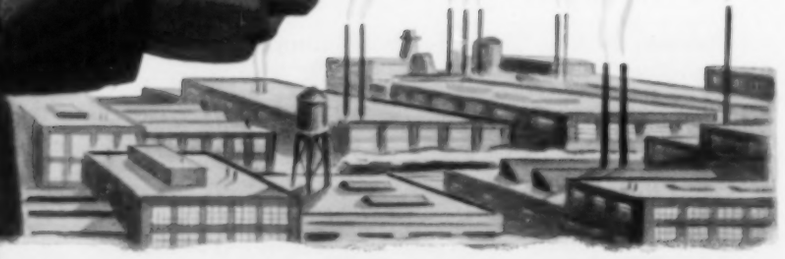
Furthermore, built-to-bend Daytons operate on short centers and permit the efficient operation of more high-speed machinery per square foot of floor space.

Located nearby to serve your wartime needs is a Dayton Distributor whose stock of V-Belts is supplemented by strategically located factory warehouses. So, for service or for helpful suggestions regarding the conservation of V-Belts through proper application and maintenance, call your nearest Dayton Distributor.

THE DAYTON RUBBER MFG. CO.
World's Largest Manufacturer of V-Belts
DAYTON, OHIO

DAYTON RUBBER EXPORT CORPORATION
38 Pearl Street New York, N. Y. U. S. A.

THROW YOUR SCRAP INTO THE FIGHT!



Dayton V Belts

LIFELINES OF POWER VITAL TO VICTORY

THE GREATEST NAME IN V-BELTS

Copyright, 1942, The Dayton Rubber Manufacturing Co.

More AIR-More Hours per Month
GARDNER DENVER 315 cu. ft. per min. compressor. Full capacity output assured from all types of compressors when lubricated with Texaco.

FOR THE ASKING... 36-page booklet "Rock Drills." Sectional views, diagrams and text to help you keep rock drills functioning efficiently. Write for your copy.

YOUR COMPRESSORS will deliver more cubic feet of air, give more hours of all-out war service per month . . . when continuously assured of carbon-free valves by the use of *Texaco Alcaid, Algol* or *Ursa Oils.*

These Texaco Oils keep compressor valves *clean*, opening wide and closing pressure-tight. They are *free* from elements that form gum, sludge and hard carbon.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred by prominent compressor operators everywhere.

These Texaco users enjoy many benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distributing points in the 48 States, or write to:

The Texas Company, 135 East 42nd Street, New York, N. Y.

THEY PREFER TEXACO

★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

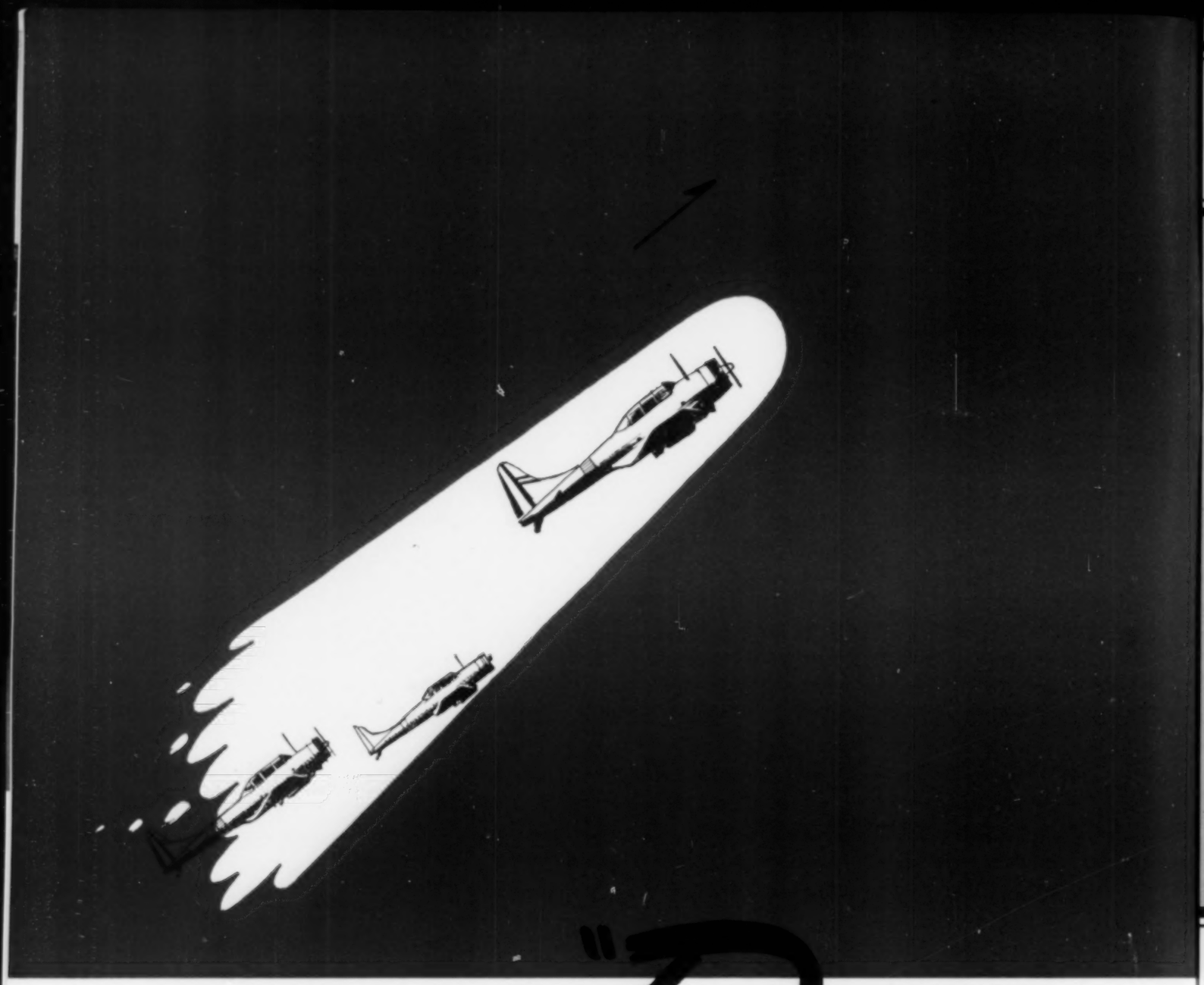
★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

TEXACO

TEXACO Lubricants
FOR ALL COMPRESSORS AND AIR TOOLS

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY



for that extra "Drive"

This is a war of horsepower as well as men, and both the nation and the machine which have the edge in quantity have the edge in the race for victory. The plane that can climb a little steeper, fly a little faster, cruise a little farther is the one that keeps its pilot from dying for his country . . . and makes enemy pilots die for theirs instead.

This extra performance isn't measured in terms of rated horsepower and ordinary overloads. It rests on the ability of the engine to deliver the last *extra* ounce of effort in the moment of need. Almost every day, news stories from the fronts bring new evidence of how well American engines are doing it . . . in many cases, with the help of American Hammered Piston Rings.

American Hammered Piston Rings were conditioned for today's job by twenty-five years of tough ring problems, that built and developed a unique organization . . . and unique facilities. The research laboratory, the foundry, the machine shop, the highly trained operators and inspectors, the engineering staff, all reflect the leadership of men who prefer pioneering to precedent, and who blaze design and production trails rather than follow them. Because of this all-inclusive "know how," where equipment must have that extra drive you'll generally find American Hammered Piston Rings on the job. Koppers Company—American Hammered Piston Ring Division, Baltimore, Maryland.

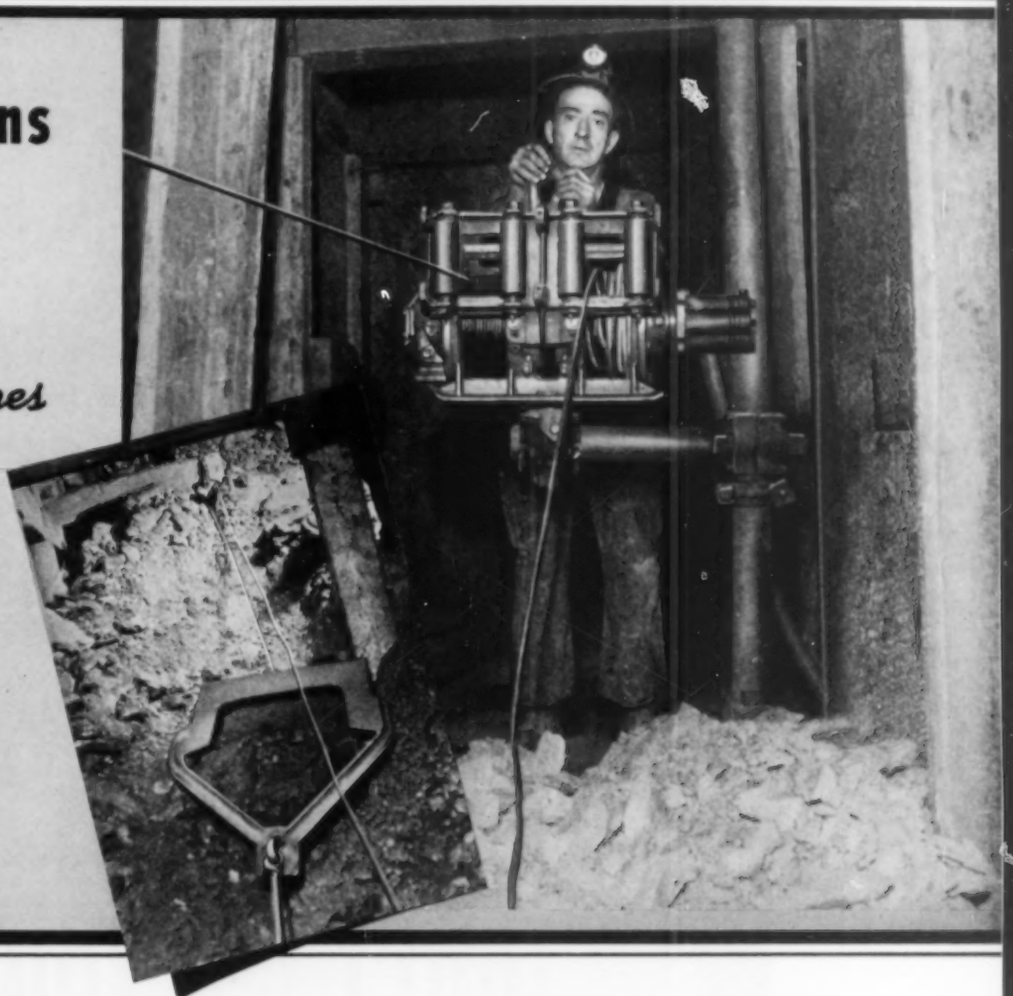
American Hammered Piston Rings

a KOPPERS product

GET IT THERE WITH AIR

Scrape 12 to 17 Tons per Hour up to 45 feet

In narrow veins or stopes



Consider your own case—wouldn't this performance help to increase your tonnage quota from those "hard to get at" working places?

The 250 lb A4NN-OJ scraper hoist can easily be carried into the working face and mounted on a column bar just like a drifter. *Let it go to work for you.*

POINTS TO CONSIDER

There is no need to bring in an electric outlet.
Raises can be spaced farther apart.
Turntable mounting will permit two-way mucking.
Area can be worked much faster.
A substantial saving in timbering is effected.
Experienced men can be kept breaking ore.
Less experienced men can operate the scraper.
Larger hoists are freed for their type of work.
The slow, costly wheelbarrow can be eliminated.
Hoist can easily be moved from job to job.
The A4NN-OJ has been serving the field over 3 years.
Hundreds of units are in use — doing "big" little jobs, saving time and increasing tonnage.

CONSTRUCTION FEATURES

EFFICIENT AIR MOTOR—Provides a smooth, steady pull—does not require a running start to get a good load underway.

ANTI-FRICTION BEARINGS—4 roller bearings and 23 generous size ball bearings are used.

PROTECTED BEARINGS—Totally enclosed and operate in a grease bath.

HOUSING—One piece, barrel-type.

SAFETY DRUMS—Housing prevents cable jumping from one drum to the other.

INDIVIDUAL CLUTCH LEVER—For each drum. Simple hand adjustment.

INVESTIGATE THE COMPLETE LINE OF I-R SLUSHER HOISTS

•

ARMY E NAVY

Ingersoll-Rand and its employees are proud of the Army-Navy "E" awarded to its Athens Plant for high achievement in supplying essential war equipment.

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Kansas City, Knoxville, Los Angeles, Newark, New Orleans, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, Tulsa, Washington

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8-216

Don't Let Your Bearing System Become "Plugged"

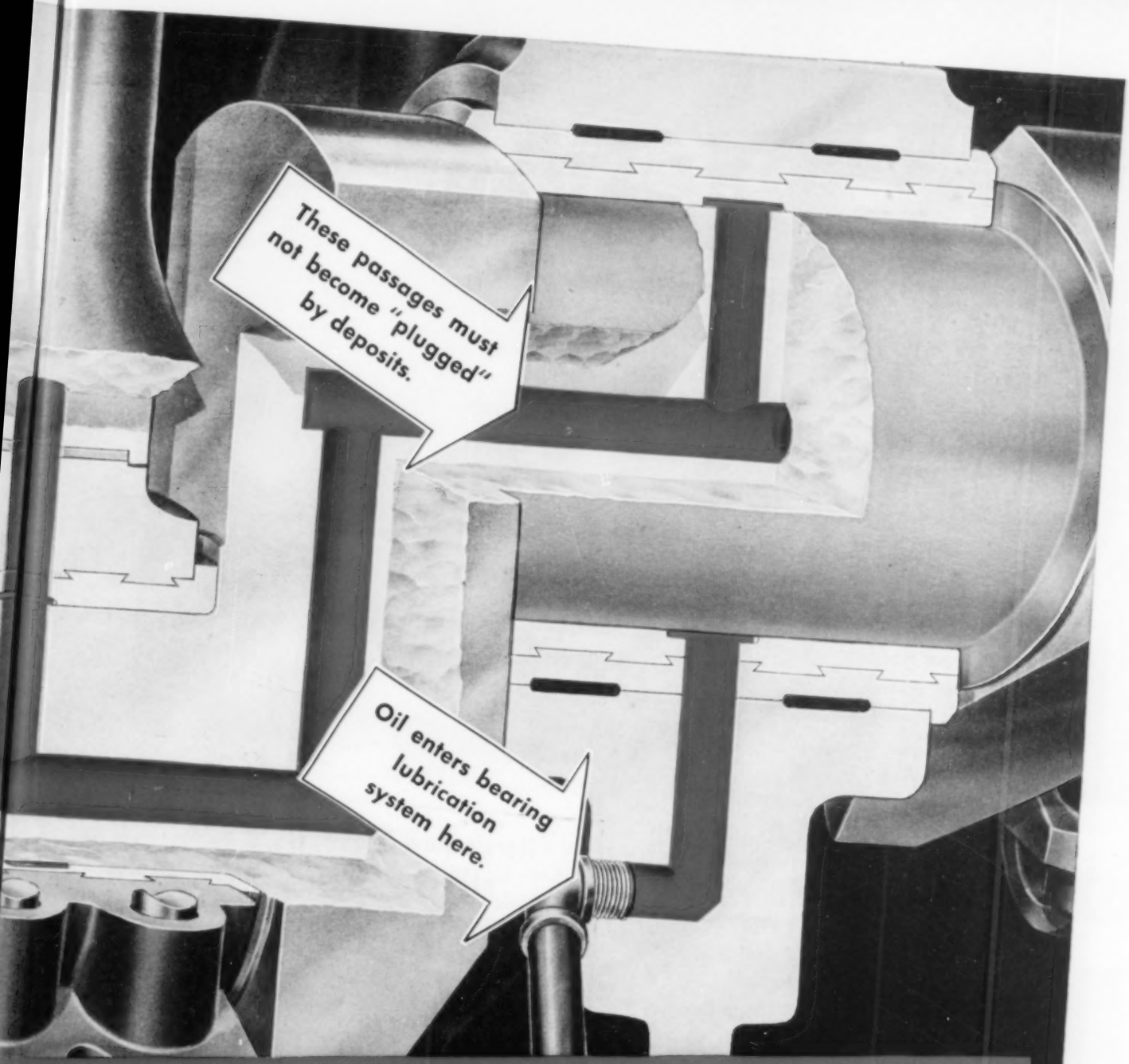
CORRECT DIESEL LUBRICATING OIL KEEPS OIL PASSAGES CLEAR

Problem: A pump forces oil under pressure through a header from which branches lead it to the main bearings. From the main bearings, it flows through holes drilled in the crankshaft and in the connecting rods to the crankpin and pistonpin bearings.

Heat and oxygen are the chief enemies of efficient bearing lubrication. Unless an oil strongly resists oxidation, sludge may form and deposits settle in the oil passages—"plug them"—and "starve" the bearing. This can result in costly repairs and time out for bearing replacements.

Answer: Gargoyle D.T.E. Oils 1-to-5 are specially made to stand up under the attack of heat and oxygen in large and intermediate size Diesels, thus resisting the formation of deposits.

Delvac Oils assure the same reliable service in small high-speed Diesels for which they were made.



TO HELP MAINTAIN WARTIME PRODUCTION, CALL IN

SOCONY-VACUUM for "Correct Lubrication"

GARGOYLE Lubricants

SOCONY-VACUUM OIL CO., INC. — Standard Oil of N. Y. Div. — White Star Div. Lubrite Div. — Chicago Div. — White Eagle Div. — Wadhams Div. — Southeastern Div. (Baltimore) — Magnolia Petroleum Company — General Petroleum Corporation of Calif.

Good BREAKAGE made EASY

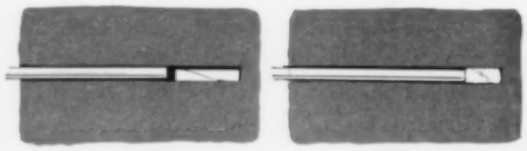
Hercules Tamptite Cartridges pack tightly without slitting. This ingenious new wrapping allows the explosive to expand inside the shell under pressure of the tamping stick.

The charge is concentrated to fill the bore-hole with minimum air space around the explosive, and no spilled powder even when loading uppers.

Result: time and labor saved, more ore or faster tunneling, better breakage for faster mucking made easy.

Ask for Tamptite Cartridges the next time you order Hercules Explosives.

Here's how TAMPTITE makes efficient Loading easy

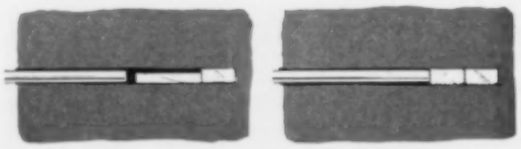


1

The regular-size cartridge goes in the bore hole. Note the space to be filled.

2

Pressure from the tamping rod compresses the powder to fill the space.



3

Another cartridge goes in—Compaction takes place inside the wrapper.

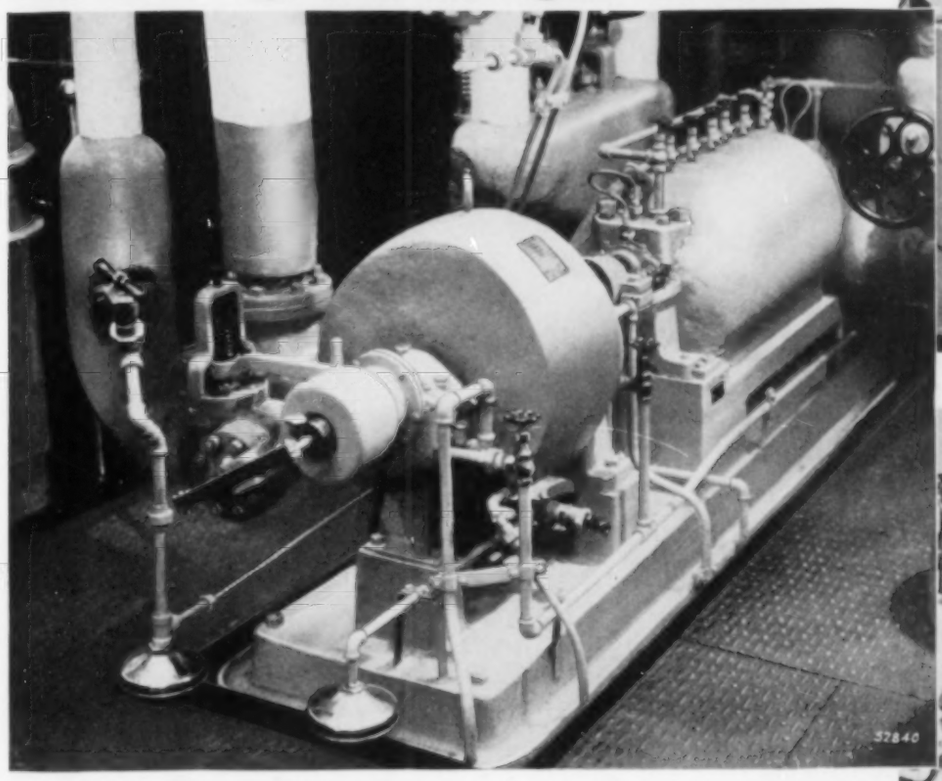
4

The charge is concentrated for better blasting results.

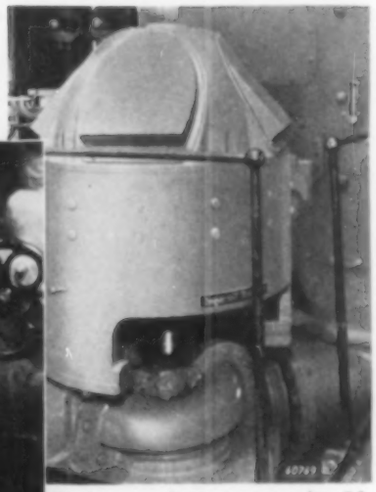
HERCULES POWDER COMPANY
INCORPORATED

932 KING STREET · WILMINGTON · DELAWARE

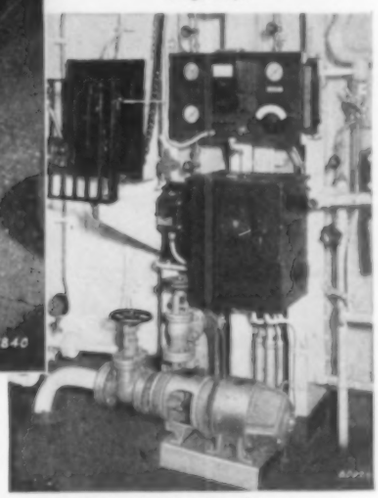
PUMPS "ON BOARD"



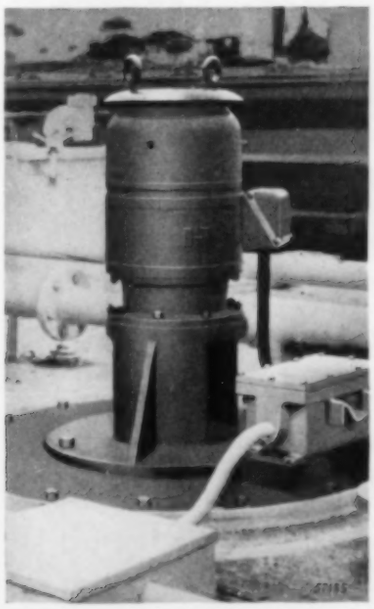
Boiler-feed pump on an army vessel.



Condenser circulating pump on a class C-2 cargo ship.



Circulating pump for Diesel engine on a cargo ship.



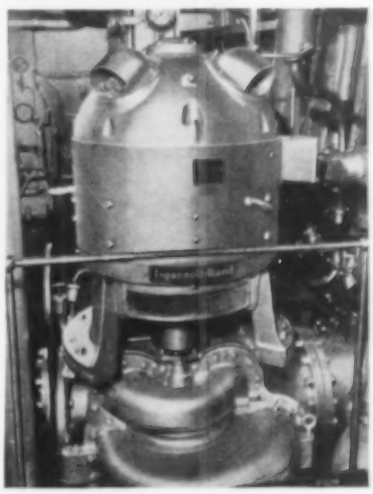
One of several cargo pumps on a tanker.

Ingersoll-Rand centrifugal pumps are serving aboard all types of vessels—navy ships, cargo vessels, tankers, ferries, tugs, etc.

Each pump in the complete I-R line is specially designed to meet requirements of particular services—circulating, condensate, cargo, boiler-feed, bilge, ballast, fire, Butterworth, sanitary, and miscellaneous.

Dependable, efficient operation is built into these marine pumps backed by Ingersoll-Rand's many years of experience in the marine industry.

Ask the I-R engineer or write for Marine Pump Bulletin, form 7071.



Condenser circulating pump on a class C-1 cargo ship.

CAMERON PUMP DIVISION

Ingersoll-Rand

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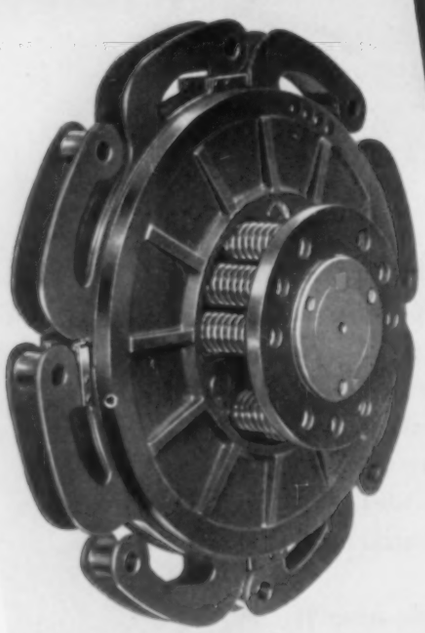
NEW YORK, N.Y.

10-188



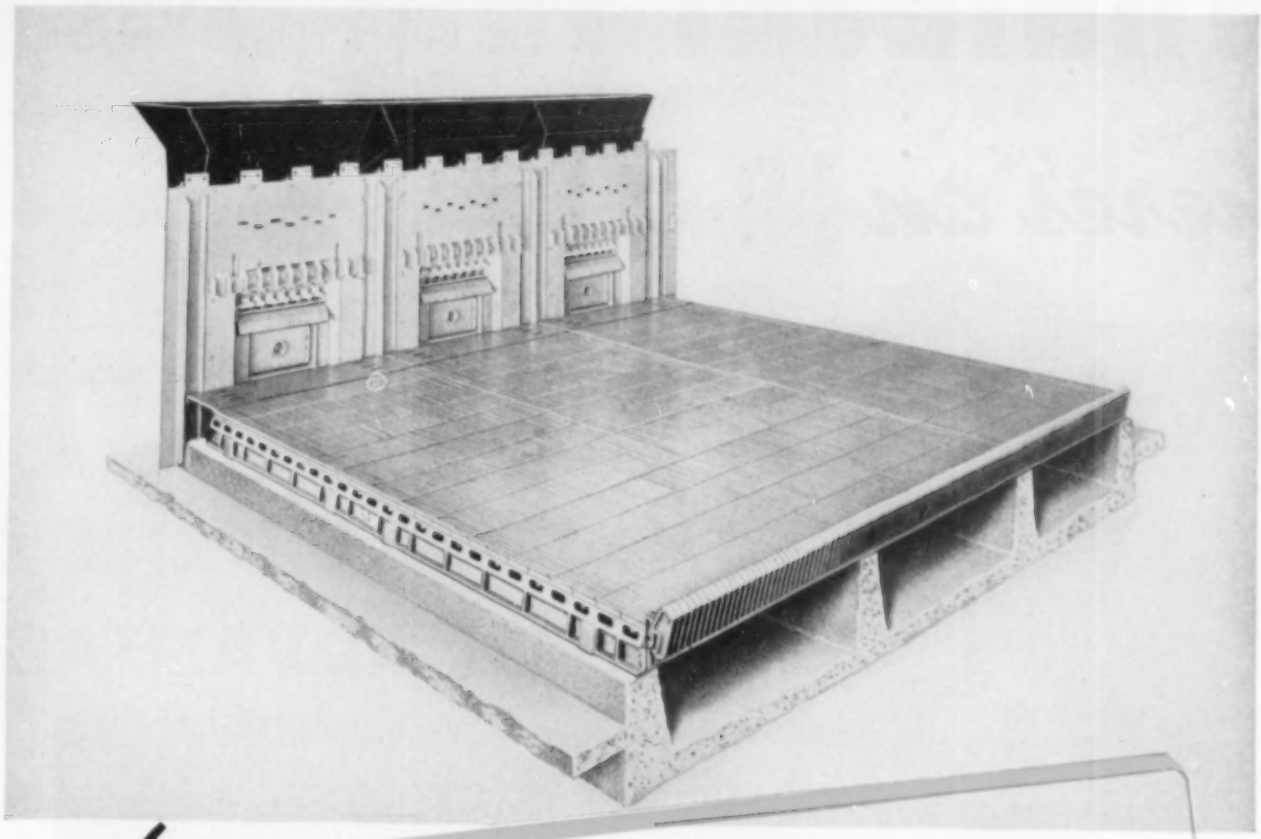
I-R Mobil-Air Compressors are equipped with *Flex-Disc* Clutches — U. S. Patent Nos. 2,177,362 and 2,259,461 and others pending.

In the Wide Open Spaces . . . .

that make splendid airports and landing fields *I-R Mobil-Air* Compressors with *Flex-Disc* Clutches are clearing away the obstacles to a level terrain. *Flex-Disc* Clutches are engineered to require practically no attention or maintenance for long periods — a boon anywhere, a necessity in isolated locations.

C. M. EASON. INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin



ALL THE ADVANTAGES OF SPREADER FIRING

plus the added values of C-E stoker experience

Present-day problems growing out of the war emergency have added new emphasis to the advantages of spreader stoker firing.

Because the spreader stoker burns a wider range of low cost coals than any other type of stoker, it is not limited by sources of fuel supply.

Because the spreader stoker, when equipped with adequate automatic control, is easier to operate than any other type of stoker, it is better suited to personnel problems of the present emergency.

Because the spreader stoker weighs less per lb of coal burning capacity than any other type of stoker, it helps to conserve critical war materials.

In addition to these inherent advantages of spreader firing, the users of C-E Spreader Stokers get the benefits of Combustion Engineering's vast experience with all types of stokers. The practical results of this experience, in terms of advanced design features and sound construction, may be judged from the fact that it is based on the manufacture and installation of over 16,700 stokers serving an aggregate of nearly 5,000,000 boiler hp.

C-E Spreader Stokers have been applied to boilers of all types, with capacities ranging from 4,000 to 175,000 lb of steam per hr. A-683

COMBUSTION C-E ENGINEERING

200 Madison Avenue New York, New York

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Whatever Your Rock

there's an I-R Drifter

THAT WILL DRILL IT TO BEST ADVANTAGE

5 Proven Rock Drills for All-Out Production

The DA-30 is an extremely fast-drilling lightweight drifter It has been designed for soft or medium hard rock —recommended for small-drift and small-tunnel work or for stopes where lightweight is essential. It is ideal also for drilling footholes in dimension stone quarries.

The DA-35 is a medium weight machine which meets the majority of drilling conditions. Its speed is comparable to that of many 4-inch bore drifters, It has strong rotation and excellent hole-cleaning ability and is particularly suitable for drilling seamy and fitchery rock.

The D-505 Tunnel-IR is the new, outstanding heavy-duty drifter for tunnels and mines Its features are, unusual durability and very high drilling speed in hard rock.

The X-71 Drifter is ideal for use on tripods or on quarry bars for drilling and broaching.

The X-71WD Drifter has been developed for wagon drill service. It has unusual hole-cleaning ability and is designed especially for deep-hole drilling.

For further information write for new catalog 2721

Ingersoll-Rand

11 BROADWAY, NEW YORK CITY

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"AMAZING" said the inquiring reporter "... to what do you attribute your long life, Mr. Tiger Brand?"

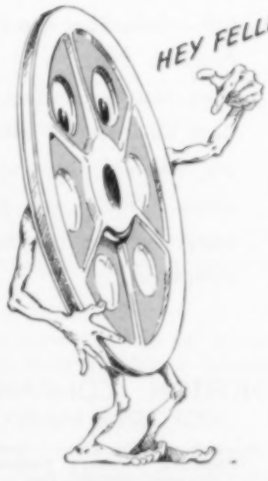
START WITH A GOOD ROPE LIKE ME
— INSTALL PROPERLY —
AND THEN

1. SLOW AND EASY BREAKING IN—

Always advisable after you install a new rope. It allows the component parts of the rope to adjust themselves to the conditions under which the rope is to operate. With Excellay Preformed this breaking-in period can be shortened — but the time spent in this early period will pay handsome dividends in added rope life.

2. CORRECT LUBRICATION.

Lack of proper lubrication is one of the most common causes for premature failure. Lubrication is required not only to protect the rope externally, but it must have sufficient penetrating power so that it will protect the inner wires against corrosion and friction. So be sure to give your wire rope periodical and careful lubrication.



3. DON'T FORGET SHEAVES

—they are of prime importance in prolonging rope life. Your sheaves must be of ample diameter to prevent excessive bending stresses in the rope. Sheaves must fit the rope —too narrow grooves will pinch and distort the rope; with too wide grooves the rope will flatten from lack of support. Worn sheaves prevent proper seating and play hob with the best of rope. And sheaves need lubricating, too.

4. IT'S ALL HERE!

48 pages, packed with practical information on wire rope handling and care, based on the experience of thousands of rope users. Send for as many copies as you need and get them into the hands of your operating men. Make sure that they follow the suggestions it offers, faithfully and consistently, and your ropes will work better and last longer. Remember, every broken rope is a "break" for the enemy.

Excellay Preformed

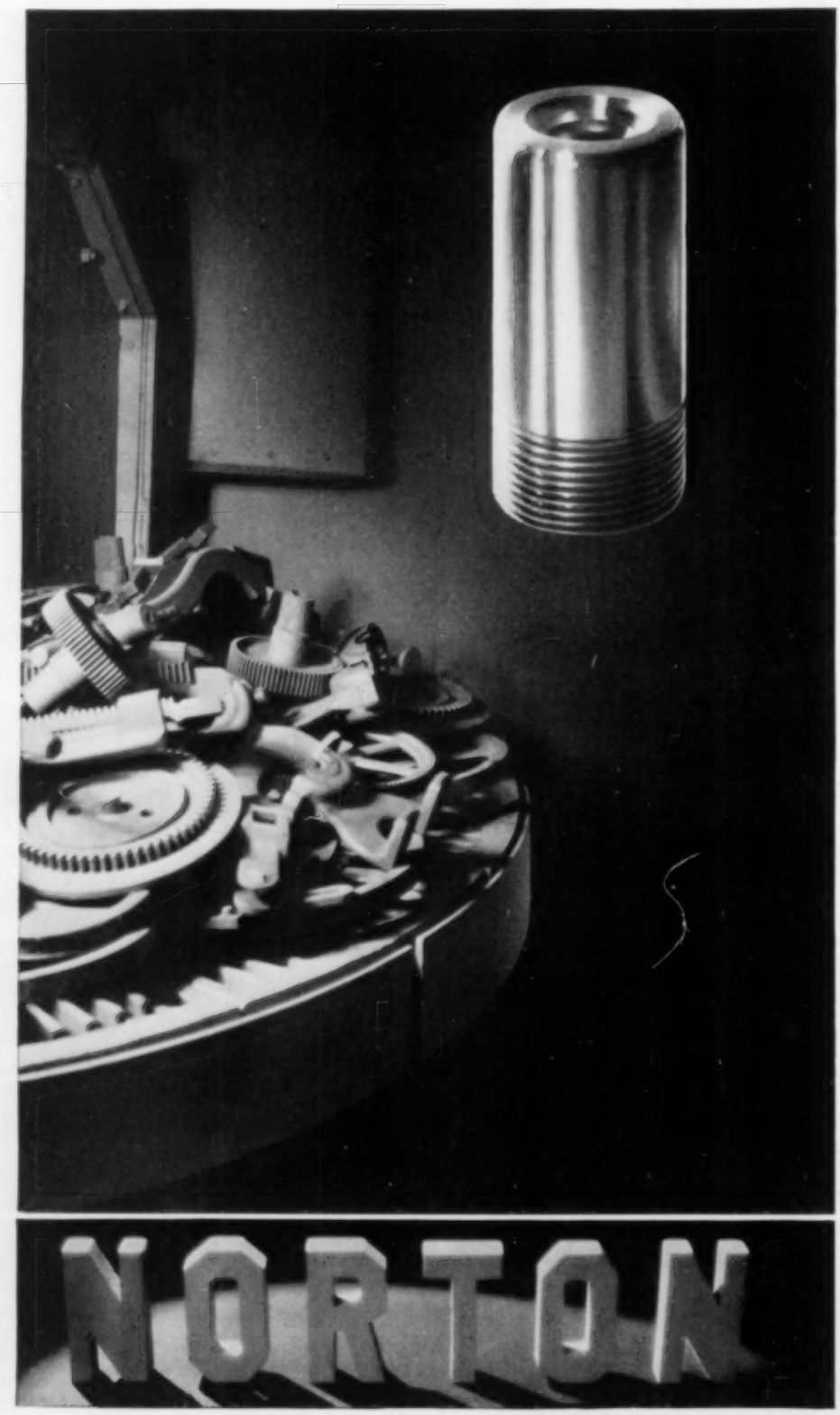
INDISPENSABLE TO AMERICA'S WAR EFFORT — GOOD WIRE ROPE!

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

USS

UNITED STATES STEEL

Cut Blast Cleaning Costs with this NORBIDE* NOZZLE



IN your cleaning room, too, you'll like the cost cutting performance of Norbide Nozzles — not only their exceptional life (at least 750 hours with sand — 1500 hours with steel grit or shot) but also the way that they decrease air consumption and maintain a stream contour and velocity that improves blasting efficiency.

A new leaflet gives full information about Norbide Nozzles — their features, instructions for selection and use, standard sizes and prices. Write for a copy — no charge nor obligation.

NORTON COMPANY
WORCESTER, MASS.

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Cleveland Hamilton, Ont.

Distributors for
NORBIDE NOZZLES
PANGBORN CORPORATION
HAGERSTOWN, MD.

*Norbide is the registered trade-mark for Norton Boron Carbide—the hardest material ever manufactured for commercial use.

N-50

ON THE COVER

OUR cover picture shows a man-made geyser that, until a few years ago, erupted regularly in Northern Michigan. It was caused by releasing the pressure of an old hydraulic compressor, one of a few that were operated on this continent. The apparatus was in the form of an inverted siphon, with the compression chamber about 350 feet below the surface. When this chamber was filled with water and the relief valves were opened, a 6-inch stream of water was thrown 100 to 150 feet in the air, producing the spectacular effect shown in our photograph. The compressor was placed in service in 1906 to furnish compressed air for the Victoria Mining Company located about 15 miles from Ontonagon in the Lake Superior copper district. The mine was abandoned around 1923, but the compressor was used for a time in 1929 to supply air for the construction of a hydroelectric project. The photograph was taken by H. P. Westervelt of Menominee, Mich., and was a prize winner in our recent cover contest.

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IN THIS ISSUE

BETTER transportation facilities among the nations of the Western Hemisphere are sorely needed to further the war effort and to stimulate trade after peace is declared. Our leading article, *North to Fairbanks—South to Rio*, tells what is being done to solve the problem.

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THE story of the most important petroleum conduit so far projected in this country is told in *The "Big-Inch" Pipe Line*. Upon this carrier the East will depend for a large portion of its fuel oil next winter. Construction crews have been breaking records in its laying, having put as much as 9 miles of the 24-inch pipe underground in a day.

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CAREY HOLBROOK and Ferenz Fedor have collaborated in a word-and-picture portrait of a group of little-known Americans in the mountains of New Mexico. It is called *Pedro's Land*. Although it has nothing to do with the fields we ordinarily cover, we believe most of our readers will find it interesting.

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WHEN Kipling wrote, "Take me somewhere east of Suez," he probably little dreamed that one day the Germans would be striving with all their military might to gain control of the canal that is the gateway from Europe to the Orient. A short article reviews its history.

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IN THE article *Steel Company 200 Years Old*, we present a brief history of the Taylor-Wharton Iron & Steel Company. A more extensive account of this firm's operations appeared in our January 1940 issue.

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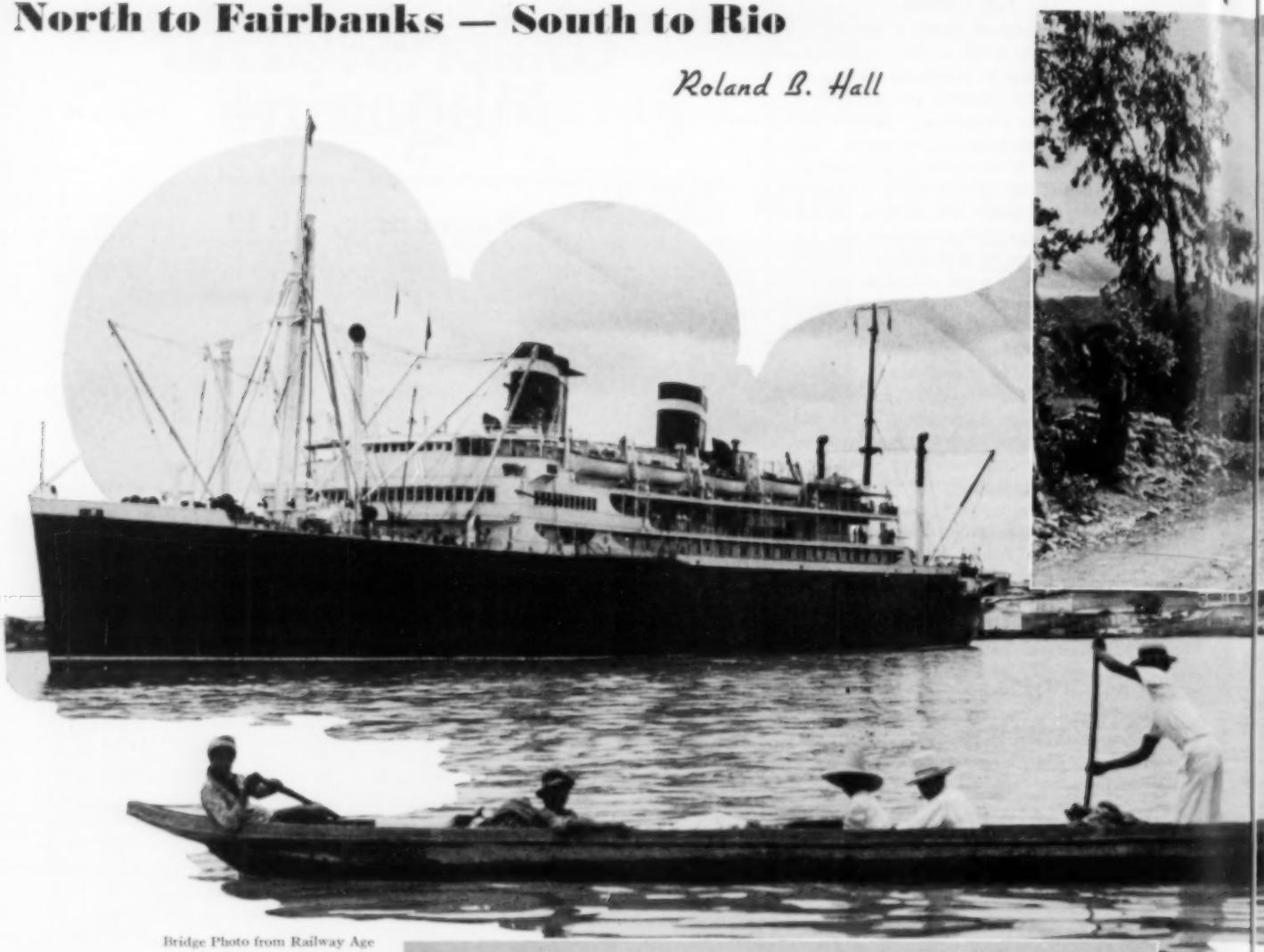
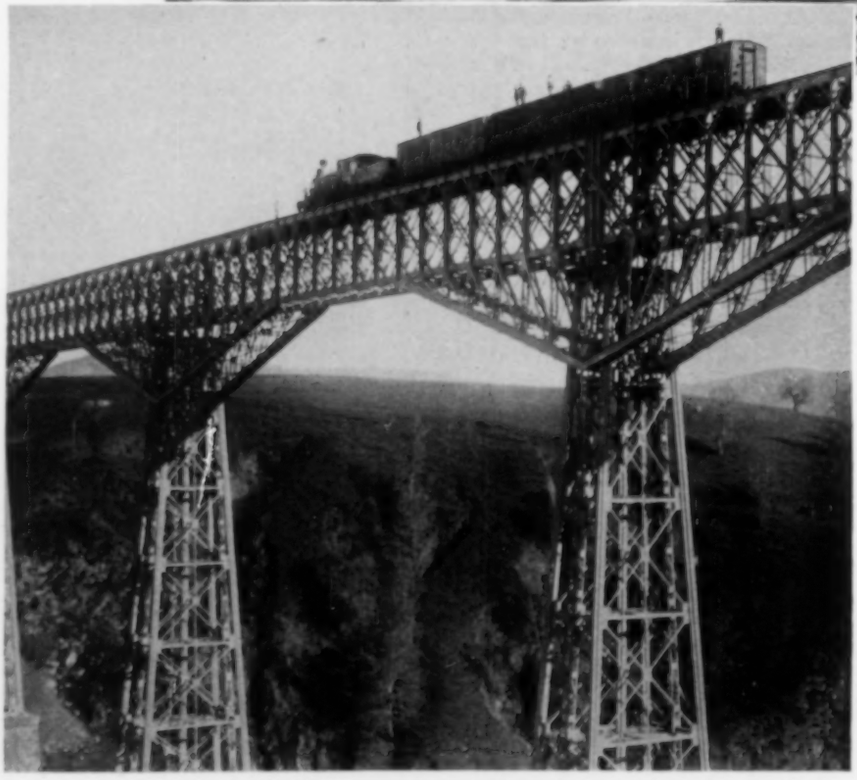
North to Fairbanks — South to Rio

Roland B. Hall



Bridge Photo from Railway Age



THE need of solidarity among the nations of the Western Hemisphere has awakened the public to another pressing need—that of better transportation facilities between the Americas. Although concerted efforts have been made to ease a critical situation, the movement of war supplies and essential materials has absorbed ship capacities at the expense of regular commerce. This condition, together with a shortage of materials and machinery in Latin America, has resulted in a sharp change in the economic pattern of these countries.

One desirable outcome of the war is the greatly stimulated interchange of goods among the Latin-American nations. The spirit of international coöperation is far more evident now than ever before and has brought about an increasing number of treaties which further encourage trade between neighboring republics. Although inter-Latin-American commerce is booming, the lack of adequate transportation has been a persistent obstacle to the development of the countries. A large-scale attempt is now being made to solve the problem through the expansion of road and rail facilities, the shortage of ships giv-

U. S. Public Roads Administration

BELOW THE RIO GRANDE

Travel and transport facilities in Central and South America include some of the fastest and also the slowest means known to mankind. They range from the clipper ships of Pan American Airways to the oxcarts of Costa Rica and the llama freight carriers of Bolivia. Shown at the upper left is the palatial ship "Santa Lucia" of the Grace Line anchored in the Guayas River near Guayaquil, Ecuador. A high railroad bridge in Chile is at the lower left.

ing impetus to the construction program.

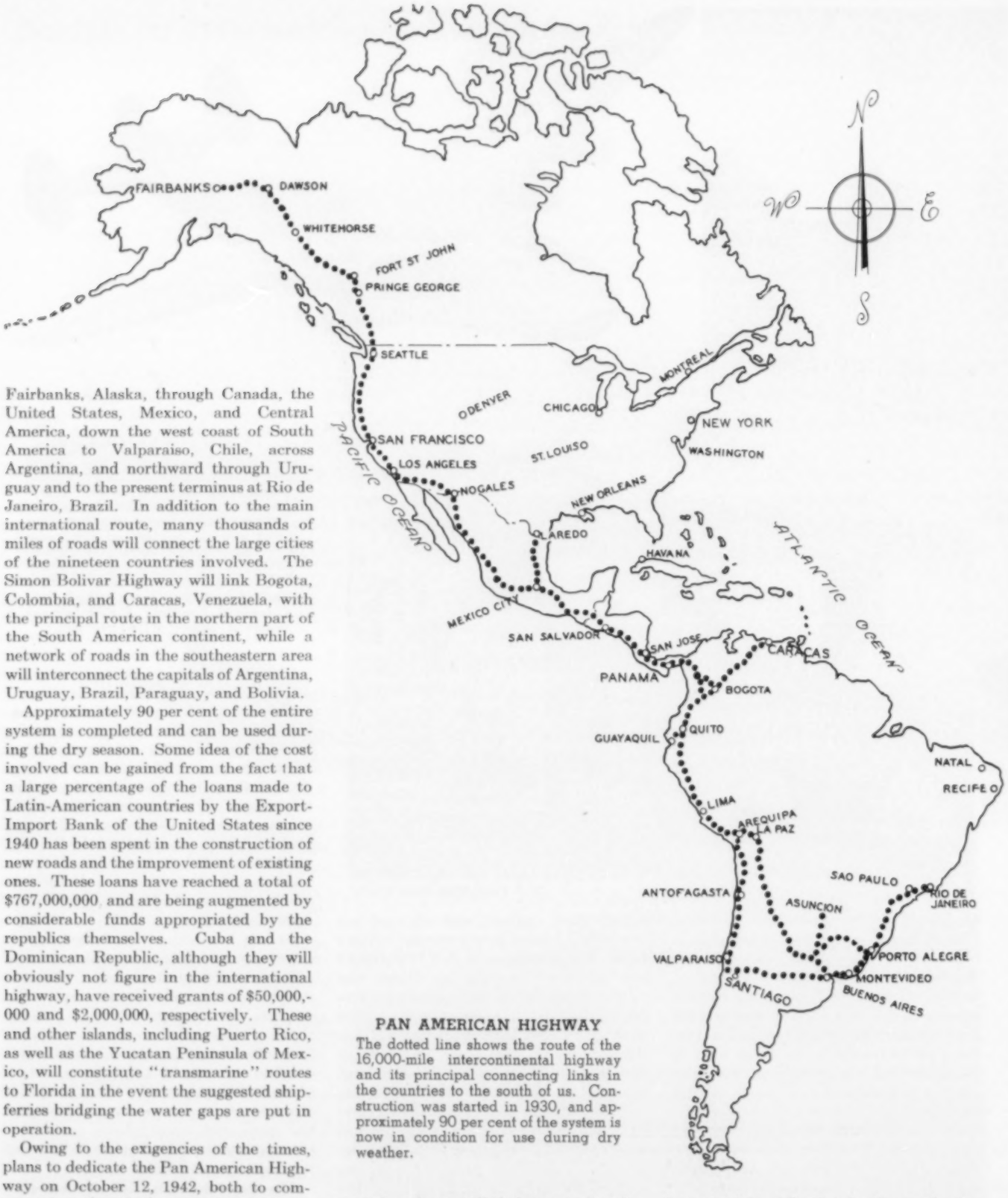
Air transport as a means of carrying on trade among the various nations of the Western Hemisphere must not be overlooked. Already the airplane has made it possible to deliver machinery and supplies to inaccessible mines and plantations that could not be reached in any other way. It has expedited the movement from one country to another of government officials on important missions, and has proved a boon to both North- and Latin-American businessmen. However, it is upon land transportation that most of the burden rests, and upon it depends the future.

The nations to the south of us are virtual storehouses of strategic materials, and hydraulic power so abundant throughout Latin America, where fuel is scarce in so many instances, will serve to facilitate the development of industries based on local mineral and agricultural resources. Tin, tungsten, antimony, bauxite, manganese, chromium, mercury, nickel, mica, manila fiber, rubber, and silk—all are available and are of great potential military value. But in many cases lack of transport has prevented opening up these vast sources of supply. It is therefore not surprising that the Latin-American republics have manifested such whole-hearted enthusiasm for the Pan American Highway that has been underway for the past twelve years. It will mark the end of the isolation era and greatly stimulate enterprise and industry. Foreign capital has been and will be required in most of the countries to carry the program to its conclusion, the same as in the case of the large steel mill now building in Brazil. In this connection it is to be remembered that the industrial growth of the United States was encouraged for years by the large-scale investment of European capital, which never imperiled our independence nor dictated our national policies.

From the time of the Spanish conquistadores to the present, the Central and South American nations have relied almost entirely upon ships to export raw materials and to import necessary commodities from other nations, including neighboring republics. In Brazil, for example, the coastal cities below the bulge depend altogether upon steamers for the interchange of their products. Except for air lines, there is no other way of shuttling back and forth. Today, if all the bottoms available for their trade were sunk or immobilized, these countries would have inadequate means of maintaining their commercial relations.

In this connection it is interesting to examine the highway and railroad maps of South and Central America. With few exceptions all the main arteries lead to the seaports—the centers of trade. Until the Pan American Highway was planned, little effort was made to connect the individual countries by an adequate system of land transportation. This is understandable, for in many cases the geography has made such undertakings practically impossible without modern machinery and the assistance of foreign capital.

The Pan American Highway was conceived in 1923 at the conference of the American Republics at Santiago, Chile. Further meetings were held and plans made, but actual construction did not begin until 1930. As first laid out, it was to connect the capital cities of the various republics, but later it developed into a huge project calling for a highway system about 16,000 miles long extending from



PAN AMERICAN HIGHWAY

The dotted line shows the route of the 16,000-mile intercontinental highway and its principal connecting links in the countries to the south of us. Construction was started in 1930, and approximately 90 per cent of the system is now in condition for use during dry weather.

Fairbanks, Alaska, through Canada, the United States, Mexico, and Central America, down the west coast of South America to Valparaiso, Chile, across Argentina, and northward through Uruguay and to the present terminus at Rio de Janeiro, Brazil. In addition to the main international route, many thousands of miles of roads will connect the large cities of the nineteen countries involved. The Simon Bolivar Highway will link Bogota, Colombia, and Caracas, Venezuela, with the principal route in the northern part of the South American continent, while a network of roads in the southeastern area will interconnect the capitals of Argentina, Uruguay, Brazil, Paraguay, and Bolivia.

Approximately 90 per cent of the entire system is completed and can be used during the dry season. Some idea of the cost involved can be gained from the fact that a large percentage of the loans made to Latin-American countries by the Export-Import Bank of the United States since 1940 has been spent in the construction of new roads and the improvement of existing ones. These loans have reached a total of $767,000,000 and are being augmented by considerable funds appropriated by the republics themselves. Cuba and the Dominican Republic, although they will obviously not figure in the international highway, have received grants of $50,000,000 and $2,000,000, respectively. These and other islands, including Puerto Rico, as well as the Yucatan Peninsula of Mexico, will constitute "transmarine" routes to Florida in the event the suggested ship-ferries bridging the water gaps are put in operation.

Owing to the exigencies of the times, plans to dedicate the Pan American Highway on October 12, 1942, both to commemorate the 450th anniversary of the discovery of America by Columbus and to symbolize the spirit of coöperation existing among the republics of the Western Hemisphere, have been dropped. However, everything is being done to push this greatest of international traffic arteries to completion with the least possible delay. All available roadbuilding equipment has been called into service, including much modern machinery that has been exported to Latin America in the past few years. However, in the case of some of the countries the purchase of large quantities of machinery has not been justified because of the low cost of labor. Furthermore, local manufacture of cement in Mexico, Argentina, Brazil, etc., is an important contribution to the road-construction program.

In the United States and Canada, all but the northernmost end of the Pan American Highway is open to traffic. From Fort St. John, B. C., to Fairbanks, U. S. Army Engineers have been struggling in a wilderness and against adverse weather in constructing what is being referred to as

SECTIONS OF THE HIGHWAY

In the picture below, tractors are at work cutting a road in a hillside. The other views show stretches of the highway in Mexico (right), in Guatemala (lower right), and at an elevation of 20,000 feet between La Paz and Palca in Bolivia.

U. S. Public Roads Administration Photos

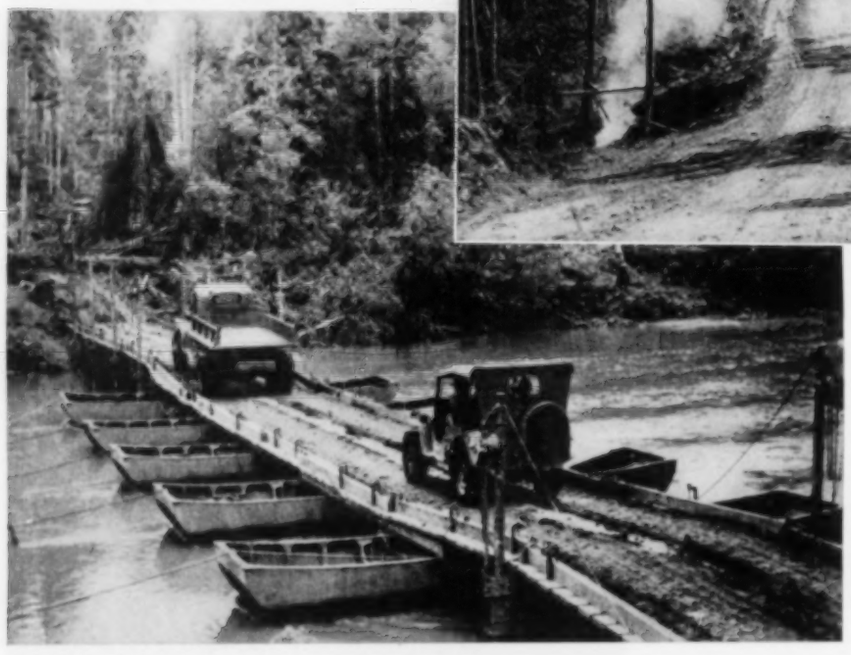
the Alcan (Alaska-Canada) Highway. Never before has a road job been tackled with grimmer determination and encountered greater difficulties. But men and machinery are conquering the forests, the sloughs, and the roaring rivers, and the indications are that trucks will be running over the last-remaining section in North America before the close of 1942. The U.S. Public Roads Administration is expected to grade and to improve this military highway, which will ultimately serve as an outlet for the fabulous mineral wealth of Alaska and encourage the development of the great Northwest.

In South America, long stretches of the route are already in regular use, and what is known as the Inter-American Highway —that part that extends from the United States-Mexico border to a point below the Panama Canal—is about two-thirds finished. This section will be approximately 3,250 miles long and will pass through the capital of Mexico and of every Central American country, except that of Honduras. There it will connect with an existing road leading to Tegucigalpa, the capital.

The quickened tempo of the United Nations' war effort has emphasized the importance of the Inter-American Highway. The early completion of this transportation link is vital to hemispheric defense, because it will make it possible to rush men and supplies by truck from railhead in Mexico at the Guatemalan border the entire length of Central America for the protection of the Panama Canal or to repel an invasion of the hundreds of miles of seacoast. To bring this about in the meantime, an emergency program has been authorized that provides for the construction of temporary roads between the Mexico-Guatemala border and the Panama Canal to link the 1,000-odd miles of permanent highways already in service there. It is estimated that 600 miles of pioneer roads will be required to accomplish this. Designed to be passable and no more, the latter will vary from 10 to 16 feet in width and will have a gravel surface 8 inches deep. Grades of 10 per cent will be permissible. Contracts for the project were awarded to several United States contractors who have put thousands of men to work closing the gaps. The prospects are that the entire stretch will be open to traffic in 1943. As this is a military operation, none of the funds made available for the permanent highway—a grant of $20,000,000 by the Export-Import Bank and a $10,000,000 appropriation by

THE ALCAN HIGHWAY

Construction of the Alaska-Canada Highway is being rushed to completion for military reasons, but in future years the thoroughfare will be a great boon to businessmen, tourists, and sportsmen. Below is pictured a pontoon bridge thrown across a river to enable men, equipment, and supplies to reach more advanced construction points. It will later be replaced by a permanent structure. The other view shows a section of the highway through heavy timber. Side ditches provide drainage, and surfacing material has been applied so that traffic can make use of the roadway during the spring thaw.



U. S. Army Signal Corps Photos

the Central American Republics—will be drawn upon for this purpose. It has been announced that the U.S. Public Roads Administration will coöperate with the Central American governments in converting the pioneer roads into permanent sections.

Mexico's highways are both extensive and modern. This is a fortunate circumstance in view of the difficulties facing the engineers that are in charge of the construction of the temporary roads through Central America, where rough country and lack of transportation facilities are hindering factors. United States motorists, of whom some 281,000 visited Mexico in 1941, can testify to the progress made there by the highway builder in recent years. Automobile traffic grew noticeably with the opening of the first section of the Pan American system from Laredo, Tex., to Monterrey, Mexico, in 1929, and again with the improvement of the 770-mile route south of Monterrey. This stretch was formally opened in July, 1936, and made through travel to Mexico City possible.

Sr. Carlos Bazán, Mexico's Director General of Highways, reported at the March, 1942, convention of the American Road Builders Association that the Mexican government has prepared a new budget for the construction of highways that calls for an expenditure of approximately $33,000,000. The figure is nearly three times that appropriated for the same purpose in any previous year. Senor Bazán has estimated that about 60 per cent of this amount will be allocated for roads essential to defense. Most of the remainder will be spent in maintaining existing roads and bridges.

Foreign Commerce Weekly, a publication of the U.S. Department of Commerce, reports that, in order to expedite completion of the highways now underway, including the Inter-American Highway between Mexico City and Guatemala, the Export-Import Bank has agreed that the credit of $30,000,000 extended to Mexico in November of 1941 may be expended in installments exceeding $10,000,000 a year. The same weekly has recently announced the opening to traffic on June 6 of the longest suspension bridge in Central America. The Puente Cuscatlan, as it is known, is 1,350 feet long and spans the Lempa River in the Republic of Salvador. It was built by a United States firm, and work on it was begun in March 1940. The entire cost of $700,000 was defrayed by the Government of Salvador.

Heretofore, Salvador's network of roads has been sharply divided by the Lempa River and its flood plain, and a trip by motor from San Salvador, the capital, to the important port of La Union-Cutuco on the Gulf of Fonseca—terminus of all rail communication between the United States, Mexico, and Central America—has entailed crossing the Lempa by ferry. Consequently, the bridge not only is a vital link in the Pan American Highway but also an important factor in the economic life of Salvador.

Even after inauguration of through traffic over the Inter-American Highway there will still remain difficulties, and these will have to be overcome before the Pan American system can be said to be in the final stages of completion. For example, between the Panama Canal and the northern part of Colombia lies a 300-mile strip of jungle that is largely unmapped. Considerable exploration will be necessary before actual construction on a permanent road can be undertaken in that region. Should this section be delayed beyond expectation, it would be possible to go around the barrier for the time being by ship ferry to nearby ports in either Colombia on the Pacific or Venezuela on the Atlantic.

Progress on the projected 8,000 miles of the main Pan American route in South America is encouraging at the present time, for the long gaps are becoming shorter and the short gaps are closing. Although the remaining links in Colombia are largely finished, that country has announced a road-expansion program for the coming year that will involve the expenditure of approximately $5,000,000.

In Ecuador, work on the Cuenca-Loja section of the highway was begun in 1941 but was slowed down because of labor troubles and other difficulties. However, a comprehensive schedule of roadbuilding, financed by a $900,000 loan made in 1940 by the Export-Import Bank, is now underway.

The coastal routes of Peru are among the best on the continent and that nation's part of the Pan American network has been completed. About 70 per cent of it is asphalted, and the remainder is largely surfaced with cemented gravel. The finished section of Peru's great trans-Andean highway, which is independent of the international system, reaches an altitude of 13,000 feet and for the first time makes it possible for the people and industries on the Pacific Coast to be in continual communication by roadway with the rich but latent resources of Peru's Amazonian jungles east of the Andes. The highway now being pushed farther eastward through the wilderness of the headwaters of the Amazon will, upon arrival at the navigable section of the Pucalpa River, create a new kind of "Panama Canal" through the widest part of the South American Continent. It will then be feasible to travel or to ship freight from the Pacific Coast of Peru overland to the Amazon and by way of that stream to the Atlantic Coast of Brazil.

Chile has for some time been conducting a progressive program of roadbuilding, which is indicated by the fact that expenditures for the construction and maintenance of highways and bridges amounted to around $7,400,000 during 1941. Work is now underway on a stretch from Santiago to Concepción, a distance of 540 kilometers (335.5 miles). Actually, this will not become a part of the Pan American system because the principal artery extends only as far south as Valparaiso, where it turns and goes southeast to Santiago, the capital, continuing thence in an easterly direction across Argentina to Buenos Aires.

Now open to traffic are large sections of the four principal roads which make up Argentina's share of the Pan American Highway. The link with Chile is nearly finished—the Buenos Aires-Mendoza section of 1,114 kilometers (692 miles) is paved and the 119 kilometers (74 miles) to the Chilean frontier have been riprapped. Considerable work remains to be done on much of the main route to Bolivia, only a moderate amount of basic construction having so far been done. Also uncompleted is a large stretch of the highway to Asunción, the capital of Paraguay. It is paved as far as San Justo, something less than halfway between Buenos Aires and Asunción, the northern terminus.

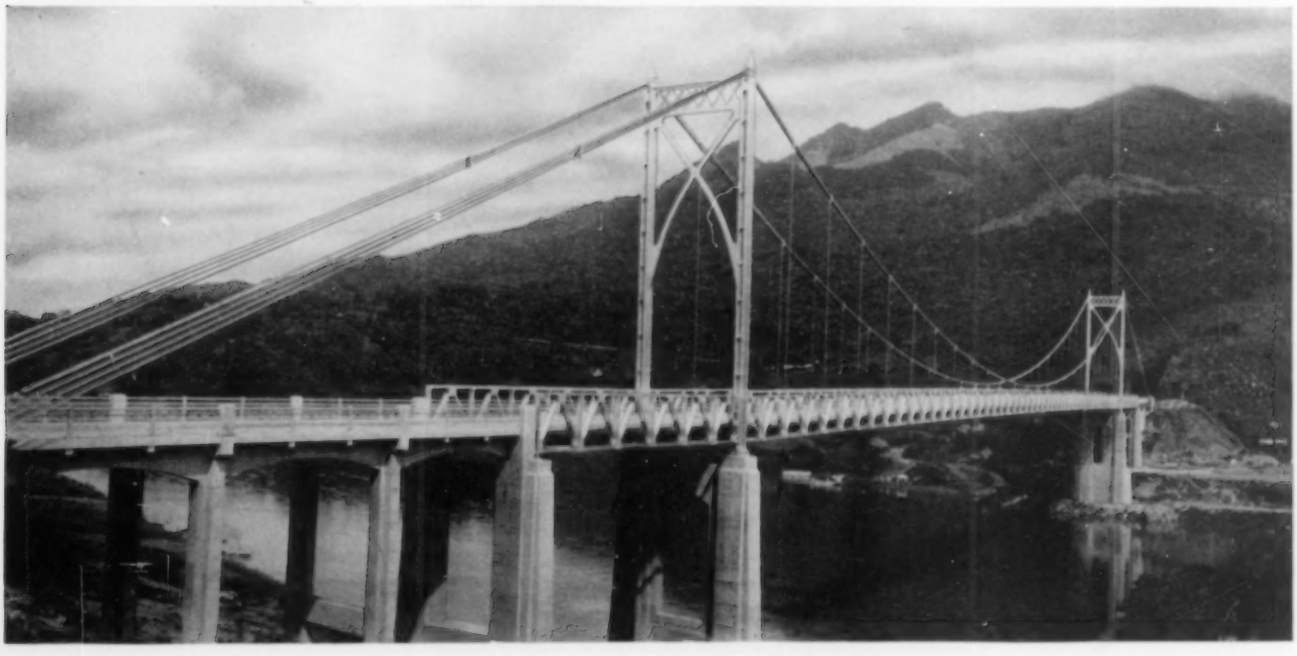
Operations are now in full swing on the fourth of Argentina's international routes, that extending northward to Uruguay. This will be one of two through highways from Buenos Aires to Rio de Janeiro, Brazil, and involves the building of a bridge across the River Uruguay at Paso de los Libres for which a contract has recently been let. The second one will start at Colonia, Uruguay, across the River Plata from Buenos Aires, and will run eastward to Montevideo and thence northward to the Uruguay-Brazil border. Both end at Porto Alegre, Brazil, from which junction a single road extends to Sao Paulo and Rio de Janeiro.

In considering the transportation problem in the good-neighbor nations to the south, the railway facilities are of the utmost importance, for highways alone are not adequate. Moreover, both local and international rail systems are essential to the large-scale operation of mineral, industrial, and agricultural enterprises. The existing lines in Latin America serve largely to haul raw materials from inland areas to seaports, and only to a minor extent for international communication. This situation will have to be changed if South

PUENTE CUSCATLAN

This new steel suspension bridge across the Lempa River in Salvador was opened to travel on June 6. It is 1,350 feet long—the longest of its type in Central America. Its cost of $700,000 was borne entirely by the republic. The span was erected by the United States Steel Export Company. Prior to its construction all highway traffic had to be ferried across the Lempa. Delays were often caused by high water and many lives and much valuable cargo were lost. The picture at the left shows Pres. Maximiliano H. Martinez of Salvador cutting a ribbon at the formal opening of the bridge. Col. Carlos Mejia Osorio, subsecretary of public works and agriculture, is in the center, and C.K. McCracken, representative of the contracting company, is on the left.

Photos from Ingenieria Internacional



America's great natural wealth and her industrial life are to be fully developed.

The submarine menace and the dearth of shipping space have led to considerable speculation as to the possibility of a railroad from the United States-Mexico border to and through the southernmost of the Central American countries. The construction of such an Inter-American route would be a costly undertaking, even though the existing rail facilities in Central America are more extensive than they are generally believed to be. The rolling stock of Mexico's principal railroads in use during 1940 consisted of 1,353 locomotives, 20,663 freight cars, and 1,354 passenger cars.

The most important of the Mexican lines is the Ferrocarriles Nacionales de Mexico (National Railways of Mexico) which has done much modernizing with respect to both equipment and roadbed in the past several years. Approximately $51,000,000 was spent in 1941 by 24 of the country's railroad companies for new equipment and maintenance, and a large number of locomotives, freight cars, and equipment is now on order. The principal line in Central America is the International Railways of Central America, which serves Guatemala and Salvador. Latest reports show that this road operates 795 miles of 3-foot-gauge track, 90 locomotives, 1,674 freight cars, and 186 passenger cars. The railroads of Salvador, Costa Rica, Nicaragua, Honduras, and the Canal Zone total approximately 1,600 miles varying in gauge from 3 to 5 feet.

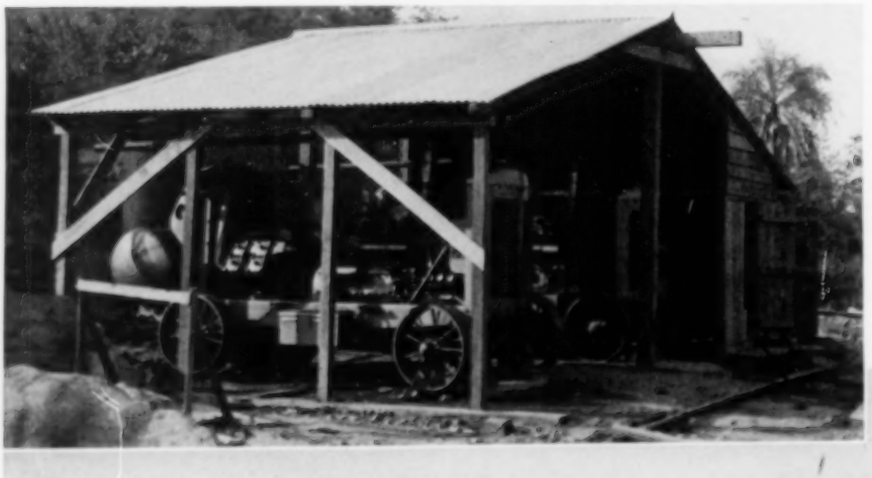
Certain freight is now being accepted by the Missouri Pacific Lines for shipment to points in Central America. The traffic is routed beyond Laredo, Tex., via the National Railways of Mexico to Pachuca, a short distance north of Mexico City; by another line to Cordoba; and thence again by National Railways of Mexico to Suchiate on the Mexico-Guatemala frontier. The latter road is now completing a bridge over the Suchiate River to facilitate the interchange of standard- and narrow-gauge cars. The opening of this span will eliminate the time-wasting practice of transferring freight by truck and ferry across the river, and carting it from there to Ayutla, Guatemala, for reloading onto narrow-gauge cars of the International Railways of Central America. Shipments over this route were formerly limited to pieces and packages of not more than 200 pounds each, but present facilities permit individual weights up to 2,200 pounds. From Ayutla the freight goes to Champerico and San José, on the Pacific Coast of Guatemala, to Guatemala City, or to Puerto Barrios on the Caribbean side of the country. In addition, the railroad extends southward to the capital of Salvador and to La Union-Cutuco on the Pacific Coast of that republic.

The two logical shipping ports of the Central and South American countries are Puerto Barrios and La Union-Cutuco, and regular steamship service has been maintained between the latter and the Pacific ports of Honduras and Costa Rica. Usually, where there is enough cargo to justify regular transportation, it is made available, and there is every expectation that steamship operations will increase as railway traffic to the aforementioned points increases. As advantage must be taken of every bit of cargo space for strategic reasons, the success of the all-rail route to Guatemala and Salvador would seem to be assured, at least for the duration.

Although the demand for railroad equipment in Central and South America is great at the present time, the belief prevails that it will continue to be heavy and perhaps even increase after the close of the war. Unquestionably, an Inter-American Railway would greatly magnify the benefits that the good-neighbor countries can count upon following the opening to through traffic of the final link of the Pan American Highway.

PARAGUAYAN ROADBUILDERS

Modern portable air compressors and Jackhamers, built in the United States, help speed construction of the highway through difficult terrain in this republic.



The "Big-Inch" Pipe Line

C. H. Vivian

Photos from Lincoln Electric Co.

FIRST ASSEMBLY OF LINE

The first weld was made on August 3 at a point near the Texas-Arkansas state line. This was less than two months after authorization of construction. It is expected that all the pipe will be in the ground by December 1 and that oil will be flowing through it before February 1.

THE world's largest oil-carrying pipe line is being laid between Longview, Tex., and Norris City, Ill., to relieve shortages in petroleum products on the eastern seaboard. Dubbed by oil men the "Big-Inch" line because of its size, it will deliver crude oil or refined products at the rate of 300,000 barrels a day. These will be transshipped eastward from Norris City through other pipe lines, by railroad tank cars, or by river barges. To expedite the laying of the 550 miles of 24-inch pipe involved, construction was divided among seven prominent and experienced contractors, and they are scheduled to have it underground by December 1.

As originally projected a year or more ago, the system was to extend all the way to the Atlantic Coast. However, the War Production Board refused to approve it because of the great amount of steel that would be required, and the line now being built represents a compromise. The undertaking has had the backing of Petroleum Coördinator Harold L. Ickes since its inception, and it was largely because of his insistence that WPB eventually sanctioned it. His convincing argument was: "You can't sink a pipe line." The work was authorized on June 10, with the understanding that the pipe would be manufactured and laid in time to be of service during the approaching winter. Indications are that that promise will be kept.

The line is being built for the Defense Plant Corporation—a subsidiary of the Reconstruction Finance Corporation—by War Emergency Pipelines, Inc., a nonprofit engineering, administrative, and construction organization. Its directing personnel has been largely drawn at no cost to the government for salaries from the major oil companies of the country. Headquarters of War Emergency Pipelines, Inc., are at Little Rock, Ark., where the unwieldy name has been shortened to Wepinc. Heading its officers is W. Alton Jones, president of Cities Service Company. Its vice-president and general manager is B. E. Hull, president of the Texas Pipe Line Company. Maj. A. N. Horne, who left his post as manager of the Empire Pipe Line Company to enter the service, has been released by the army to serve as vice-president and superintendent. J. W. Cason of the Standard Oil Company of Louisiana is acting as treasurer and comptroller, and H. M. Lingle of the Humble Pipe Line Company is purchasing agent. Oscar Wolfe, formerly chief engineer of the production department of The Texas Company, is chief engineer of lines. Lester M. Goldsmith, chief engineer of the Atlantic Refining Company, served until recently as chief engineer of pumps and terminals, his services having been donated to supervise pump-station design. The advisory engineering committee is composed of Mr. Goldsmith, W. R. Finney of the Standard Oil Company of New Jersey, and C. H. Kountze, of the Sinclair Refining Company. Charles P. Cather is supervising engineering for the Defense Plant Corporation.

The Defense Plant Corporation will own and operate the line, which is estimated to cost $35,000,000. It is not now known what its status will be after the war is over. Opinion among oilmen is divided as to whether or not it will be needed under normal conditions, but most of them believe that it will be operated at partial capacity. There is a possibility that it will later be extended to the Philadelphia-New York area. Although it is ordinarily cheaper to transport oil by tanker than by pipe lines, it is pointed out that the "Big-Inch" line will effect greater economies than usual because of its large capacity.

In addition to the main line, the contracts now being carried out provide for

Photos from Oil Weekly

CLEANING AND COATING PIPE

Before being placed in the ground, the pipe is cleaned, coated with enamel, and wrapped with heavy asbestos-felt paper to protect it against corrosion. The cleaning and priming machine (left) is so large that the operator rides it both to control it and to escape some of the dust from its revolving brushes. It travels the pipe under its own power, but is supported by an outrigger arm with a wheel at its outer end. The enameled pipe (right) is held high enough by side-boom tractors to provide clearance for the revolving wrapping machine shown at the right. The wire slings by which it is supported are equipped with rollers that move along without damaging or so much as marking the hardened primer coat. When ready for lowering, the pipe weighs about 100 pounds per foot. To handle this load the tractors have to be counterbalanced heavily on the off side to keep them from tipping over.

the laying of two laterals from Norris City—a 14-inch branch to Mount Vernon, Ind., from which point barges will move oil up the Ohio River to Pittsburgh, and a 10-inch line to Enfield, Ill., where a connection will be made with the Illinois Pipe Line Company network. This will deliver oil to Chicago and Toledo for transshipment by lake tankers and barges. It should be pointed out here that a considerable amount of the oil transported through the "Big-Inch" line will be consumed in the Middle West. It is expected, however, that a minimum of 150,000 barrels will reach the Atlantic States daily. Some of it will be drawn from the line before it reaches Norris City so as to take advantage of existing storage tanks and tank-car loading racks belonging to other pipe-line systems. It will be necessary to provide tanks for storage at Longview, Norris City, and Mount Vernon, and efforts are being made to locate used materials for that purpose to keep down the consumption of new steel. In order to augment the supply of oil for the system, plans are being made to reverse the flow through several existing lines that run from the Longview area to refineries in the Beaumont-Port Arthur-Houston section in Texas. It is contemplated running fuel oil through at times, although this will not be done during very cold weather because the high viscosity of fuel oil would materially reduce the volume that could be sent through daily.

To push the oil through the line there will be ten pumping stations, located at average intervals of 55 miles. An interesting sidelight of this phase of the operations is that it will require twelve days just to fill the pipe, which will hold 3,500,000 barrels of oil. Each station will house three single-stage centrifugal pumps each driven by a 1,500-hp. motor. Ten of these pumps are now being built by Ingersoll-Rand Company. The pumps in each station will run in series and the pressure in the final unit will be raised to around 750 pounds per square inch. As it was specified that no critical materials should be embodied in the pumps, they are being built of high-strength cast iron, and the design has been suitably modified to enable the machines to meet service conditions.

When WPB rejected the original application for the project because of the amount of steel that would be required, investigations were made of possible substitute pipe materials. Concrete, glass, wood, fiber, plastics, and reinforced fabrics were considered, but it was found that none of them would be suitable unless used in combination with considerable quantities of steel or copper. The steel pipe being utilized is classed as Grade B under the specifications of the American Petroleum Institute. It is drawn, seamless tubing with a 3/8-inch wall thickness and weighs 94.62 pounds per foot. It is being manufactured by the National Tube Company at its Lorain, Ohio, mill. The contract shipping schedule calls for deliveries of 100 miles in July, 160 in August, 140 in September, 130 in October, and 20 in November.

The contractors for laying the line and the section each is handling are:

Williams Brothers, Tulsa, Okla.—Longview, Tex., to the Texas-Arkansas state line.

O. E. Dempsey Construction Company, Tulsa, Okla.—Texas-Arkansas state line to Gurdon, Ark.

Anderson Brothers, Tulsa, Okla.—Gurdon, Ark., to Little Rock, Ark.

Oklahoma Contracting Company, Dal-

las, Tex.—Little Rock, Ark., to the Arkansas-Missouri state line.

C. S. Foreman Company, Kansas City, Mo.—Arkansas-Missouri state line to Illmo, Mo.

Ray E. Smith Construction Company, Eldorado, Kans.—Illmo, Mo., to Harrisburg, Ill.

Sheehan Pipe Line Construction Company, Tulsa, Okla.—Harrisburg, Ill., to Norris City, Ill. Also the branch lines from Norris City to Mount Vernon, Ind., and to Enfield, Ill.

Williams Brothers was also awarded the contract for running the line across the eight largest streams that intersect the route. These are the Red, Little Missouri, Ouachita, Arkansas, Cache, White, St. Francis, and Mississippi. The latter will be crossed below Cape Girardeau, Mo.

The procedure of the pipe-laying gangs follows standard practice, with such modifications as pipe size and weight may dictate. Although the line is exceptionally large for an oil carrier, considerable lengths of 24-inch gas line have been laid in the Mid-Continent area, and contractors have consequently developed a technique for the handling of large pipe. Division of the work among seven contractors was calculated to expedite it for two reasons: First, it would permit operations to proceed simultaneously at a number of places and, second, no contractor would have such a large section that he would be compelled to buy new equipment and perhaps wait for it to be delivered.

Preliminary surveys for the line were made from the air last summer, and with the general route thus determined it took only a short time for the ground crews to complete the work after construction was authorized. The ditching, stringing, and laying of the pipe all call for the use of unusually large mechanical equipment. The trench is 30 inches wide, and the ditching machines required to excavate it to the specified depth are so heavy that bridges on many secondary roads have to be reinforced to enable them to reach the right of way. The pipe is delivered in 40-foot sections and strung out along the line, and in assembling the units the beveled ends of abutting lengths are tack-welded by one crew followed by a second crew that completes the job by running three beads around each junction point. All welding is done with electric units.

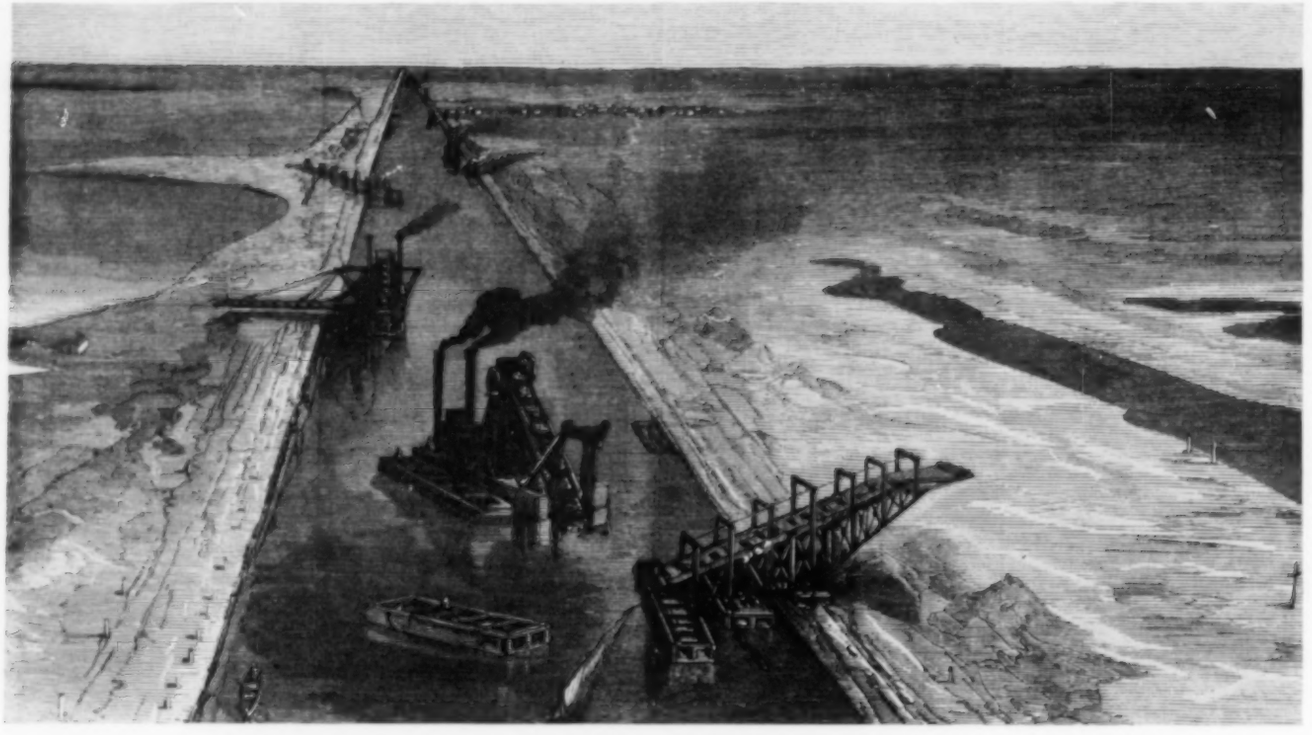
ROCK WORK

This picture, which was taken during the construction of another pipe line, shows the use of portable compressors and Jackhamers in trenching through rocky ground. Aside from an occasional boulder, little rock has been encountered on the "Big-Inch" line, but all contractors have portable compressors and air-driven tools on hand to cope with hard ground when necessary.

As on all pipe-line work, pneumatic equipment is being employed to advantange, but very little rock is being encountered. Consequently, the amount of drilling and blasting required is small. However, all the contractors have portable compressors on the job, together with the usual complement of drills, paving breakers, clay spades, and backfill tampers. Compressed air is regularly used for the burners needed in making bends in the pipe sections, the zone where the bend is desired being heated. If an underbend is wanted, the pipe is supported at both ends and allowed to sag of its own weight. To make an overbend, only one end is supported and the other one is allowed to sag. For side bends, the section is treated in either of the ways just described and then rotated 90° in one direction or the other.

Before being lowered into the trench, the pipe is coated with enamel and then wrapped with asbestos-felt. When finally ready, it weighs approximately 100 pounds per foot. To handle it, the side-boom tractors used have to be extra counterweighted on the off-boom side. When an assembled section, with the open end plugged, is lowered into the trench it is so buoyant that it will float in 8 inches of water. It is therefore necessary to pump out the trench before putting in the pipe. Despite the difficulties of handling pipe of this size, the experienced crews of each contractor have been laying from 4,800 feet to more than a mile a day and averaging around 5 miles a day collectively.

Editor's Note: Since this article was written, the steel for the 857-mile extension to the Atlantic seaboard has been allocated.



CONSTRUCTING THE CANAL

From 1859 until 1863, much of the work was done by Egyptian laborers furnished by the viceroy. When these were withdrawn, mechanical equipment was introduced and progress greatly accelerated. This view showing dredges in operation was reproduced from a woodcut that appeared in the March 20,1869, issue of Harper's Weekly.

The Suez Canal

ONE of the rich prizes at stake in the fighting in Libya is the Suez Canal, lifeline of trade between Europe and the Orient. The status of the waterway is anomalous. It is owned by a private company and, theoretically, is open to use by all the nations in peace or war. Now it is under the control of British soldiers, and for the second time in a third of a century its banks are almost a continuous armed camp. No Axis shipping has passed through since hostilities started, and the route has presumably been largely abandoned by the English as a thoroughfare to the Far East since enemy submarines became a serious menace in the Mediterranean Sea. Nevertheless, it still possesses enormous strategic value.

The Suez Canal, although of relatively modern construction, is of ancient conception. The idea of linking the Mediterranean and Red Seas is almost as old as civilization itself, and the work was accomplished several times in days long past. In fact, there is some evidence that the first of these waterways was built some 4,000 years ago. However, the course of the early canals differed from that of the present one. Instead of being a direct north-and-south connection between the two seas, they took off from the Pelusiac arm of the Nile River and ran eastward to the head of the Red Sea, which formerly extended several miles farther north than it does now. As a matter of fact, Nature provided most of the channel, as the Pelusiac branch overflowed in flood seasons and filled the depression known as the Wadi Tumilat, which reaches almost to the Red Sea. All that the ancient workers had to do was to deepen the shallower sections of this watercourse; but, even so, that was a formidable task with the equipment at hand.

According to the writings of Aristotle, Pliny, and Strabo, the legendary King Seostris of Egypt built the first such canal. He is also supposed to have conquered the entire known world of his day, although there is reason to believe that he was only a mythical figure concocted by the Egyptians as a matter of national pride. However, an inscription at Karnak indicates that a canal was in existence at the time of Seti I (1380 B.C.), and sections of its channel are still visible in the Wadi Tumilat. The Pharaoh Necho, who lived around 600 B.C., sought unsuccessfully to provide another canal, and Herodotus wrote that 120,000 men died in the attempt. Nearly a century later Darius completed the work that Necho started. Neither this waterway nor the previous ones were directly connected with the Red Sea because of an obstructing stretch of high ground just west of it. Ships using the canal ascended the Pelusiac arm of the Nile, then followed the former to Heroopolis, where their cargoes had to be unloaded and transported overland to vessels in the Red Sea. This final section was canalized by Ptolemy Philadelphus in 285 B.C., and at the junction point he built the town of Arsinoë. During the next 300 years the Nile reformed its delta, causing the Pelusiac branch to become virtually dry and making it impossible to use this route. That was in the reign of Cleopatra (31 B.C.). Trajan, or more likely the Arab ruler 'Amr who conquered Egypt in the seventh century, restored it and extended it westward to Old Cairo. From time to time various rulers closed the waterway to keep their enemies from using it, with the result that it became clogged here and there with sediment. However, as late as 1861 sections of it were inundated whenever the Nile overflowed, and its line was followed to some extent by the French engineers when they built a fresh-water canal in conjunction with the Suez Canal.

The cutting of a direct waterway across the Isthmus of Suez was considered in the eighth century by Harun al-Rashid, but he decided not to attempt it because he

did not want to provide the Turkish navy with a means of reaching the coast of Arabia. Following the discovery of the route around Africa to India near the close of the fifteenth century, the Venetians urged the Egyptians to dig a canal. This Turkey opposed, and nothing was done. Louis XIV of France gave thought to the project in 1671, but the work was not undertaken. The age-old scheme came to the attention of Napoleon Bonaparte when he was in Egypt in 1798, and he ordered his engineer J. M. Lepére to make a survey. When the latter reported that there was a difference in elevation of 29 feet between the Mediterranean and the Red Sea, Napoleon lost interest because of the apparent need of extensive locks to operate the waterway.

Early in the next century Claude Saint Simon, French socialist, urged the construction of the Suez and Panama canals to bring the nations closer together. In 1847 one of his followers, Prosper Enfantin, organized the Société d'Etudes pour le Canal de Suez whose engineers subsequently proved that the two bodies of water were at virtually the same level. Ferdinand de Lesseps, who had been associated with the Saint Simonists and who was later to dig the canal, became the chief proponent of the scheme in 1854. De Lesseps was the son of a former French vice-consul to Egypt, which was ruled by viceroys named by the Turkish government. Upon the death of Viceroy Abbas Pasha, de Lesseps' close friend, Said Pasha came into power and soon invited de Lesseps to Egypt to visit him. While they were crossing the Libyan Desert from Alexandria to Cairo, they discussed a canal, and the viceroy asked him to draw up a memorial on the subject.

In the winter of 1854-55, de Lesseps and two French engineers, Linant Bey and Mougel Bey, made a survey of the isthmus, and in March, 1855, delivered to Said Pasha a report that convinced him that the scheme was feasible. It was decided to run a canal from Suez on the Red Sea to Pelusium on the Mediterranean, and to extend it at either end by means of jetties to provide the necessary depth at the entrances. It was to be 325 feet wide at the top and 26 feet deep. Its cost was estimated at 160,000,000 francs ($32,000,000) and the time required for construction was set at six years.

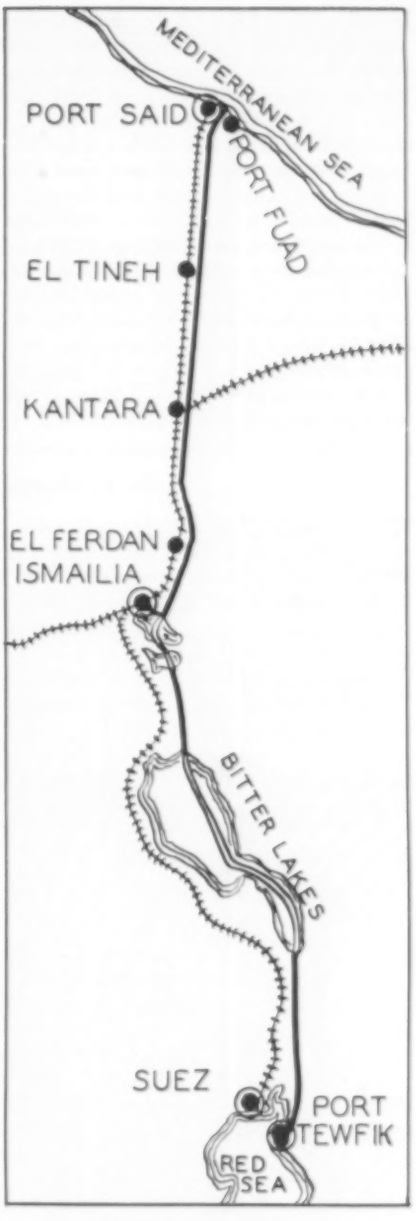
FERDINAND DE LESSEPS
President and manager of the French-controlled company that built the Suez Canal.

Concessions were granted to de Lesseps, and in 1858 he formed a company to sell its 400,000 shares at 500 francs each. In less than a month 314,494 shares were subscribed for, most of them in France and Turkey. Viceroy Said Pasha took the remaining 85,506 shares. The English had opposed the scheme as impractical, and invested practically nothing in it. Russia, Austria, and the United States also did not participate. Later, however, after the canal had been completed, Lord Beaconsfield prevailed upon his government to take an interest, and in 1875 England bought 176,602 shares for approximately $20,000,000, including the holdings of Said Pasha.

De Lesseps' original plans were referred by the viceroy to an international commission in 1855, and only minor changes were made in the route. The line passed through three natural depressions that are now Lake Timsa, Lake Menzala, and the Bitter Lakes. The concessions granted the company all the land it would require to excavate the waterway and for quarrying needful stone. Ownership of the canal was vested in the company for 99 years, after which it was to pass to the Egyptian government unless other arrangements were made meanwhile, and during this period 15 per cent of the profits were to go to the Egyptian government. In addition to the maritime canal the company was obligated to dig a fresh-water channel from the Nile near Cairo to Lake Timsa, with branches from that point paralleling the course of the main canal. Tolls were to be the same for ships of all nations.

De Lesseps served as president and manager of the company, and his chief engineer was Voisin Bey. Work was started by de Lesseps and a group of Arab laborers at Port Said in 1859. The port was located on a low, narrow sand bank, and the first huts to house the workmen were built on piles. More than 1,000 acres of solid land was formed in dredging a harbor and channel. To keep out the mud brought down by the Nile and to protect shipping from storms, two jetties—6,000 and 8,100 feet long, respectively—were run out into the sea. These were constructed of masonry blocks, weighing up to 20 tons each, made of lime, sand, and water compressed in hydraulic molds and dried in the sun for from two to three months.

Other sections of the canal were then undertaken, using the labor of 20,000 *fellahs* or peasants, feudal workers of the viceroy, under the terms of the concessions. Although these laborers were paid and treated better than they were under their former status, the Khedive Ismail, who succeeded Said Pasha upon the latter's death in 1863, intervened and demanded of the Turkish sultan that their service be ended. This was ordered under penalty of stopping operations by force if the command was not complied with. The company was paid an indemnity and also recompensed for relinquishing certain lands that had previously been awarded to it. Abolition of the forced labor system turned out to be a good thing, for it brought about the introduction of mechanical equipment and better engineering methods.



ROUTE OF THE CANAL

At that time the work was divided into four contracts, three covering excavation and the fourth furnishing blocks for the

jetties at Port Said. Two of the former were afterwards consolidated and carried out by Paul Borel and Alexandre Levalley. For 29 miles southward from Port Said the canal runs through Lake Menzala, a shallow body of water with a mud bottom, then through 2 miles of sand hills, 8-mile Lake Ballah, and a deep cut to Lake Timsa. The latter cut is the deepest in the canal and extends 60 to 70 feet below the surface. After passing through Lake Timsa the waterway enters another artificial channel which connects with the 24-mile Bitter Lakes, terminating in a cut extending to a point in the Red Sea 1-mile southeast of Suez. Most of the material was soft and easily removed. In low areas, water was admitted to permit the use of floating dredges. Some rock was encountered, chiefly near the southern end. A total of 96,938,066 cubic yards of material was excavated. Where the freshwater canal from the Nile reaches Lake Timsa, about midway of the maritime canal, the town of Ismailia was established, and it was there that de Lesseps had his home during the construction period. The waterway is 101 miles long and was formally opened with inaugural ceremonies at Port Said on November 16, 1869. On the following day 68 ships of many nationalities, led by one that carried the Empress Eugenie of France, started through it, reaching Suez three days later. Regular service was established immediately, and in 1870 around 500 vessels made use of the canal.

Although the company sold no stock other than the original shares, it was obliged to raise additional money to complete the work by borrowing, selling land, and by other means. Total expenditures to the end of 1869 amounted to 432,807,882 francs, or more than double the original capital. However, the venture has been a very profitable one, each share having returned more than eight times its cost in dividends. In recent years the market value of the shares (par 250 francs) has been as high as 18,000 francs. The original toll for the passage of a vessel was ten cents a ton, as indicated by the ship's papers. The rate was raised in 1872, but several reductions have been made since then. Prior to the war the charge was seven francs per ton for loaded vessels and 4½ francs for those in ballast. The fee per passenger has remained ten francs since the canal was opened. Cargo traffic in 1936, the latest year for which figures are available, was 32,378,883 net registered tons. In a normal year 55 per cent of the shipping was British, with Dutch, German, and French ships next in importance.

From time to time the canal has been improved. Except in the Bitter Lakes section, two vessels could originally pass each other only at certain designated places. In 1876, in 1885, and again following the first World War, the channel was widened and deepened so that large ships can now pass even at bends. The depth is such that vessels drawing 38 feet of water can negotiate the passage. Beginning in 1887, ships equipped with electric searchlights were permitted to use the waterway at night, and this reduced the average time of transit from 36 to 15 hours. Since then it has been cut to 13 hours, 22 minutes. The maximum speed is 7½ miles an hour. The canal is managed by 32 administrators of whom 21 are French, ten British, and one is Dutch.

During the first World War the Suez Canal remained open to Allied and neutral shipping, save for a few hours on February 3, 1915, when a Turkish army of 12,000 to 15,000 troops reached that point. Those that crossed on pontoon bridges were killed or captured, and after a further attack on the following day the Turks withdrew and did not return. When peace came, considerable engineering work was undertaken. In addition to the widening and deepening program previously mentioned, a city was built just east of Port Said and named Port Fuad in honor of Egypt's ruler, who dedicated it in 1926. This was done to reduce congestion at Port Said. All the company's engineering and repair shops were moved to the new community, where homes were erected for the employees. During normal times the company employs an operating and maintenance force of some 2,000 men.

B. F. Shepherd Honored

THE 1942 Albert Saveur achievement award of the American Society for Metals was bestowed last month upon B. F. Shepherd of Phillipsburg, N. J., metallurgist for Ingersoll-Rand Company. The presentation was made during the annual convention of the society in Cleveland, Ohio. Mr. Shepherd received the award in recognition of his several contributions to the knowledge of metals. The award derives its name from the fact that Doctor Saveur, long considered the dean of American metallurgists, was the first man to receive it. The American Society for Metals was formed during World War I. It is the leading society in its field, with a membership of more than 14,000.

Photo from Compressed Air Institute

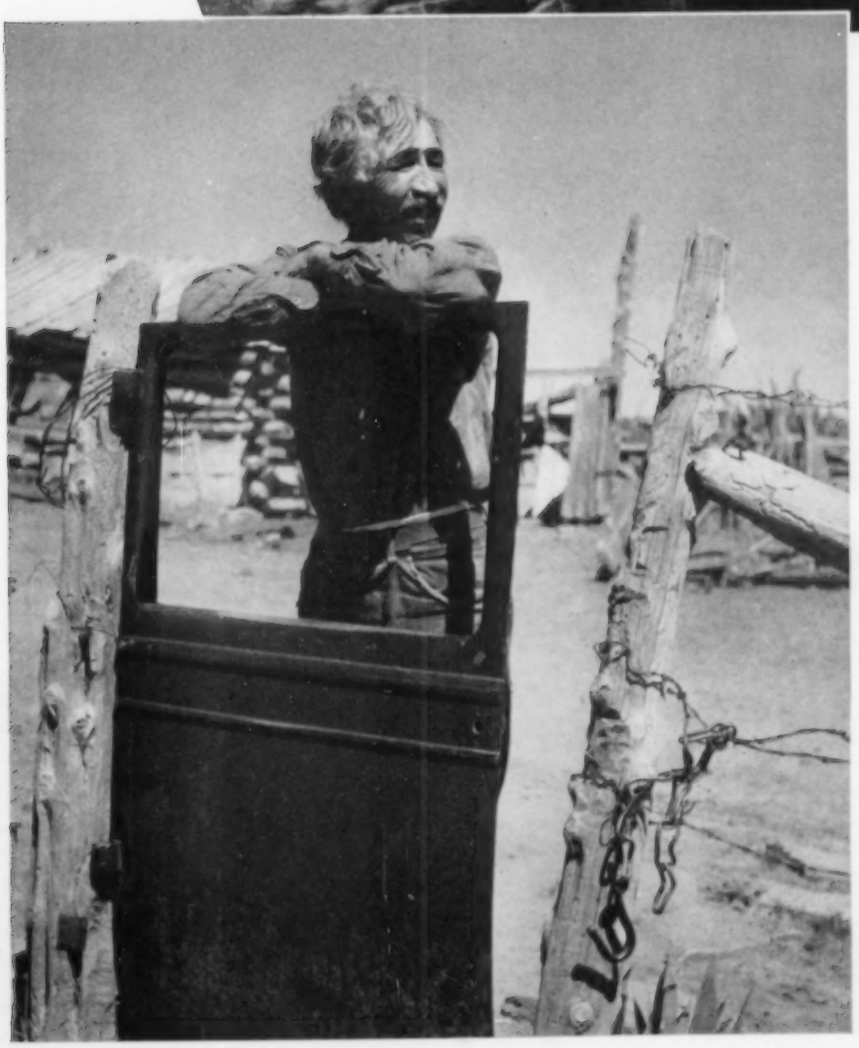
PNEUMATIC-TUBE TERMINAL

This striking picture shows the central station of the pneumatic-conveyor system used by the Cleveland Graphite Bronze Company, manufacturer of bearing bushings for the navy. There are 13,000 feet of tubes and 26 stations. The longest line has a reach of 1,200 feet, and a tube carrier 3 inches in diameter and 12 inches long travels through it in 40 seconds. More than 1,000 letters, blueprints, etc., are sent through the transfer system each working day.

Pedro's Land

Carey Holbrook

Photographs by Ferenz Fedor



NOT every loyal American speaks the English tongue. In the little mountain villages of New Mexico live men and women who trace their ancestry back to the shores of Spain. In spite of the fact that many of them live within 20 or 30 miles from a city they are primitive people, tilling the same soil and following the same customs their fathers followed and their grandfathers before them.

Although these people speak only the Spanish tongue they are Americans! Pioneer Americans, if you please, springing from a sturdy race that trickled into this land in the wake of Coronado and held it against the raids of roving red men and the hardships of a bleak land.

Such a man is Pedro Salazar. Pedro of the white teeth and flying hair, Pedro Salazar—American!

•

Consider Pedro Salazar,
  He never owned a shining car,
He never held the wealth of men
  All golden in his hand.
Come sunny days, come days of rain,
  He bends his back, and bends again,
And whispers to the friendly earth,
  "This land, she's Pedro's land!"

She's Pedro's land! The pride of birth
  Transmitted by a bit of earth
And burning in the hearts of men
  Who follow Freedom's star;
Like you, perhaps, who really rate,
  And you who watch, and you who wait;
Like you, and me, and Old John Dough,
  And Pedro Salazar.

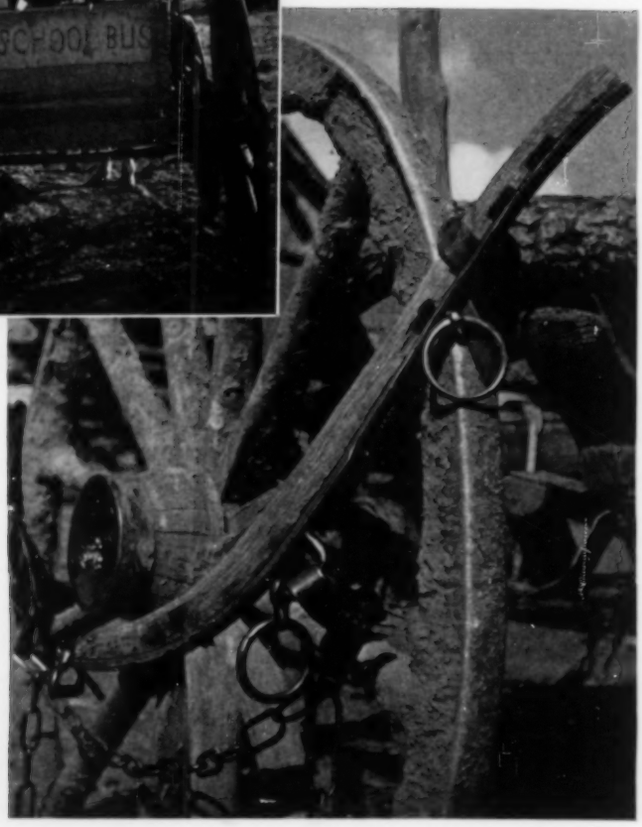
•

Water

PEDRO'S land lies in a rough country. Above his house the Rocky Mountains sweep away into rolling peaks. Below, the land drops into a series of ever-widening terraces where beans and corn, growing in cramped fields, struggle through the short summer. Pedro's land could be called any number of names and still ring true. It could, for instance, be called Canyoncito and not go very far wrong. There are many Canyoncitos in Pedro's land.

There is no speculation as to the reason this village came into being. Indeed, all the villages in Pedro's land were founded for one simple reason—water! Somewhere high in the mountain above Canyoncito a singing spring leaps from the rugged earth and tumbles down toward the valley. For the first mile or so the water races around the rocks and sweeps downward in a mad rush. Then the land flattens off into a bench, where the speed of the stream is checked. Here, on this bench, is Canyoncito, here on the mountainside where water is to be had—ice-cold water born of snowy mountain tops.

Somewhere back across the years one of Pedro's forefathers came upon this spot in the mountains. Soft green was the grass along the edge of the waterway. Here he made his home, back yonder when America was young. Here to this day live the descendents of this same roving son of Spain, the Zamoras, the Luceros, the Gutierrezs, the Raels, and the Salazars—Americans all. Canyoncito! A village with a past but no written history.

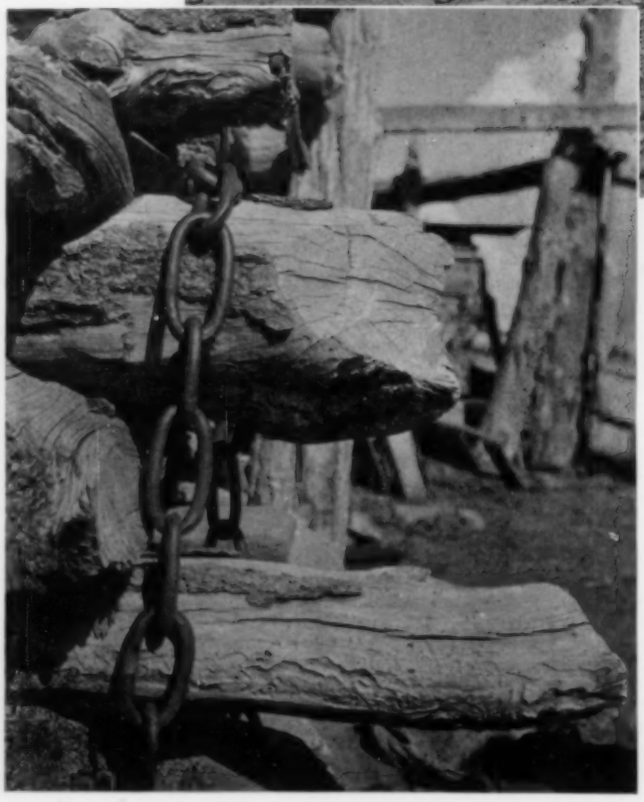


The Family

NINE children from the village of Canyoncito attend school at San Antonio, a few miles down the mountainside. Even as is done in more prosperous communities, the district furnishes a bus to transport the children to and from school. The vehicle makes its regular trips over roads impassable during many days of the school year for anything except a wagon. So the school bus for the children of Canyoncito is a wagon. Frank Lucero has driven it for the past four years. Sometimes the snow is deep along the trail. Sometimes the thawing ruts are heavy with mud that clings to spoke and felloe. But the bus goes through behind the sure feet of a pair of mountain horses, whose ancestors ran the woods and dropped their colts in some forest glen.

The children of Pedro's land come early and often to the young couples that are wed in the church of San Lorenzo. Scattered among the villages are native midwives who officiate at the births of the majority of the children. If a doctor is needed for the event, he is called from the city 22 miles away! Children in Canyoncito cling to a precarious life until they reach maturity. The infant death rate in Pedro's land is one of the highest in the nation. Deficiency in diet plays havoc with the health of the boys and girls, but in spite of that they are happy and full of laughter. No child of Canyoncito pines away for love and companionship from its parents. There are no prouder parents anywhere in the world than the ones in Pedro's land.

Canyoncito



IN MANY of the villages of Pedro's land the houses are made entirely of mud, including walls, roof, and floors. But in Canyoncito, high on the mountainside, the construction is varied. Some of the ancient dwellings are a combination of log, and rock, and mud. Long-lasting construction went into these sturdy walls that have turned back the suns of uncounted summers and stood guard against swirling wintry blasts. Some of the houses reach out along the hillside in a long succession of rooms that straggle across the face of the hill. Babies were born in those darkened chambers long before the Santa Fe Trail made its rutted way to the coast. The grandchildren and the great-grandchildren of those babies still cultivate the pocketsize fields around Canyoncito. Their wagons still creak along the same narrow mountain roads, crawl out on the ribbon of concrete at the foot of the hill, and wend their way loaded with wood to a not-too-distant city. For their own fuel, when winter's snow lies deep, wood is also used. Each morning a supply is cut for the day's use. Each night the last stick goes into the fire, and no more is provided until breakfast time.

Canyoncito folks, and all the folks of Pedro's land have very little use for blooded stock. The chickens which scratch out a living around their corrals are of a motley breed, hatched under a brush pile and living by virtue of agile legs and sharp eyes. Their horses are wood's colts, eking out a bare living from a bare pasture. Their cattle are wild-eyed and sparsely built.

The Church

SIMPLE folks are the dwellers in Pedro's land, living close to the scant soil on the mountainside. To them the church is the living symbol of a just God, and their village priest a holy man to be honored, and trusted, and believed. Even when the whoop of the redskin still rang in the hills of Pedro's land the people had their altars and their time of worship. Today, in every Canyoncito in Pedro's land their own church stands close beside the sweet water that gives their village life. Within its portals are hard benches and hard boards worn smooth by kneeling parishioners. Once a month a priest visits the flock, coming from some larger community. Once a month the edifice echoes to the chant of a solemn mass sung by a black-clad priest of the Catholic faith. Once a month bent figures come and go, crossing themselves and lifting eyes of faith to their patron saint.

Reverend people dwell in Pedro's land, and their patron saint, Saint Lorenzo, looks down from a candle-lighted niche in some chosen home each year. On the tenth day of August the people of Canyoncito celebrate the fiesta of San Lorenzo, and the figure of the patron saint is carried on straining shoulders and left with another honored family for a year. It has always been so in Pedro's land. Flickering candles burn upon their altars. On their hillsides stands the cross of Christ erected to the glory of God. Canyoncito and all of Pedro's land bear witness to the power of a rugged cross and the teaching of a faithful padre.

Steel Company 200 Years Old

THE Taylor-Wharton Iron & Steel Company, which has made munitions for every war fought by United States forces, observed its 200th anniversary on October 17 at High Bridge, N.J. The concern is the outgrowth of an iron forge established near High Bridge by William Allen and Joseph Turner in 1742. The present firm was the first in the country to cast alloy steel, and this year also marks the 50th anniversary of that event. Owing to the restrictions on travel, the celebration at High Bridge last month was not so extensive as orginally planned. Speakers included the company's president, George R. Hanks, and representatives of the army and navy. The faculty and students of High Bridge High School presented a pageant based on the concern's history.

PAST AND PRESENT

The industry that is now the Taylor-Wharton Iron & Steel Company had its beginning on December 1, 1742, when William Allen of Philadelphia leased 3,000 acres near the present site of High Bridge, N.J., and erected a forge. The first-known advertisement using the Taylor name was an offering of nail rods in the New Jersey Gazette of December 6, 1780 (upper left). Shown above is the entrance to the present office building at High Bridge which was erected more than a century ago. From left to right the figures are: L.N. Aller, treasurer; George R. Hanks, president; and Charles B. Andrews, secretary to the president.

Allen and Turner, the founders of the business, were both prominent in colonial affairs. Allen, who had been educated abroad as a lawyer, was mayor of Philadelphia and chief justice of the Supreme Court of Pennsylvania. In 1730 he bought a portion of the ground on which Independence Hall in Philadelphia now stands. After the erection of that historic structure he was the first person to put it to public use, the occasion being a banquet given by him upon his retirement as mayor. Although of lesser prominence as a public figure, Turner served on the Philadelphia Common Council and also in the Provincial Assembly.

On December 1, 1742, Allen leased 3,000 acres of land containing iron deposits and situated adjacent to a forge, the ruins of which still stand on Taylor-Wharton ground. He built and operated a new forge. Ten years later he and Turner bought the original forge and mine, as well as the land on which the new furnace had been erected. They also constructed a new slitting mill the remains of which and of the other works are still visible. In all, they owned some 10,000 acres, much land being required in those days to supply wood for the charcoal that served as fuel in smelting the iron ore. Most of their holdings were disposed of after the wood and iron ore had been exhausted.

Robert Taylor, the first of five Taylors to be identified with the concern, started working as a bookkeeper for Allen and Turner when a young man only a few years removed from Ireland. The operations were then known as the Union Iron Works. The attention of the management was directed to Taylor by a petition he wrote on behalf of the employees, and in 1769 he was made manager. In 1775 the plant turned out its first munitions, a shipment of cannon balls for the Philadelphia Committee of Safety. Allen donated his share, but Turner accepted payment for his half. One of the molds used to cast those missiles is still owned by the Taylor-Wharton Iron & Steel Company. During the Revolution, John Penn, last colonial governor of Pennsylvania and son-in-law of Allen, was interned at the Union Furnace, along with Benjamin Chew, Chief Justice of Pennsylvania and a relative of Turner. They were placed in the custody of Taylor, who lived in a stone mansion on the grounds. Penn named it "Solitude" because he was lonely there. The structure was occupied by several of the later Taylors and has been kept in a good state of preservation.

Around 1780, when Allen and Turner were both well along in years, Taylor was put in charge of the iron works and ran it in his own name. He continued as the proprietor for twenty years after Allen and Turner died, and it was not until 1802 that the property was divided among four

heirs of the partners. The following year Taylor bought for $1,464 a tract of 366 acres which included the mansion "Solitude," the forge, and much of the land now within the limits of High Bridge.

During the War of 1812 the plant made supplies for the U.S. Army and also farming equipment and fittings for the famous Conestoga wagons which were the "prairie schooners" in which many pioneers traveled to the West. A limited amount of material was also supplied to the army during the Mexican War. Robert Taylor died in 1821 and was succeeded by his son, Archibald S. Taylor. The latter conducted the business until his death in 1860, when his son, Lewis H. Taylor, took over. The third Taylor ran the works under his own name for a time, then under the partnership of Large & Taylor. In 1868 the business was incorporated as the Taylor Iron Works, and Lewis Taylor became its first president.

The coming of the railroad to High Bridge helped the plant by enabling it to bring in anthracite coal and also iron ore to supplement the dwindling local supply. It also provided transportation for its products and gave it business in the form of rails, coupling pins, car wheels, and axles. As a result, the iron-making facilities were expanded. The works continued to prosper, and in 1877 was producing 50 axles, 100 car hooks, and 100 car wheels daily. It was operating five trip hammers, and power was furnished by two turbines turned by the waters of the south branch of the Raritan River.

The present era of the company's activities began in 1892, when it obtained the American rights to manufacture manganese steel, which was developed by Robert Hadfield in England. The Taylors already had considerable railroad business and thought that the new material would be acceptable for making railroad-car wheels. They poured their first casting on October 29, 1892. Much to their chagrin, manganese steel turned out to be unsuitable for the purpose, but they soon discovered it to be the best obtainable metal for rails, frogs, and switches by virtue of its capacity to withstand sudden impacts, to which such trackwork is subjected. In conjunction with William Wharton, Jr., & Company of Philadelphia, the Taylor works, on August 28, 1894, put in place on a Brooklyn, N.Y., street railway the first frog with a cast manganese-steel center plate. It stood up well in service, and other street-railway installations followed.

Steam railroads were reluctant to accept the new material, and it was not until January, 1900, that the first manganese-steel crossing was put in use in Philadelphia. At about the same time a similar frog was installed at the Broad Street Station in that city, and this lasted 25 times as long as an ordinary steel frog. Thereafter the new material was widely accepted by railways, and it continues in favor today for track sections that must withstand heavy impacts. Because so much of the railroad business was done through William Wharton, Jr., & Company, that concern was absorbed in 1912. Knox Taylor, who took over the helm of the High Bridge works when his father died in 1908 at the age of 97, became the first president of the newly formed Taylor-Wharton Iron & Steel Company.

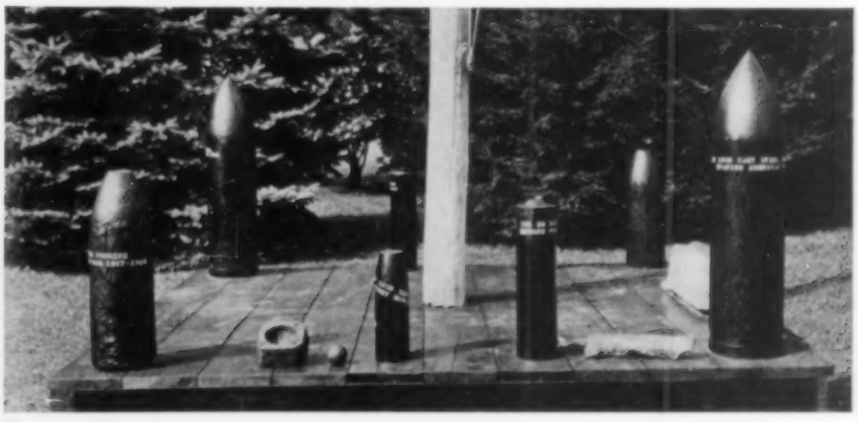
Meanwhile, the U.S. Army and Navy had adopted the high-carbon, cast-steel projectiles made at the Taylor works under Hadfield patents, and many 8-, 10-, and 12-inch shells were supplied for the Spanish-American War. During the battle of Santiago Bay, one of them was shot clean through the *Cristobal Colon*, pride of the Spanish Navy. During this period, manganese steel in the teeth of power-shovel buckets came into wide use. Virtually all the mechanical shovels employed on the Panama Canal had "Panama dipper teeth" made at High Bridge.

In 1915 a new plant was built in Easton, Pa., and during the First World War it manufactured 538,136 shell forgings, as well as forgings for naval guns, tank treads, helmets, and for railroad and marine equipment. Knox Taylor died in 1922 and was succeeded as president by his cousin, Percival Chrystie, who served until 1929, when Mr. Hanks took over the guidance of the concern.

Prior to the attack on Pearl Harbor, one of the company's chief products was manganese-steel dredge buckets. Literally thousands of these, some of them weighing more than 2 tons, were made at High Bridge for tin dredges in Malaya and in the Netherlands East Indies, as well as for platinum and gold dredges throughout the world. Before the tin-deposits in the Far East fell in the hands of the Japanese, the dredges, numbering nearly 200, were purposely wrecked. Another of the company's principal products in recent years has been drawn- and seamless-steel cylinders for hydrogen, oxygen, and other gases. Thousands of these containers are turned out every year, and facilities for making them are now being expanded to meet increased military demands. Taylor-Wharton is also manufacturing manganese-steel tank treads, and special manganese-steel rail equipment for army camps and naval bases, as well as for the nation's railroads. In addition, it is continuing to make special manganese-steel equipment for essential industries.

MUNITIONS FOR MANY WARS

Taylor-Wharton has furnished material for every war in which United States forces have engaged. The exhibit shown below is on the company grounds at High Bridge. Front row, left to right: 9.2-inch-shell forging, First World War; mold for casting cannonballs, Revolutionary War; small grenade, Revolutionary War; 6-inch-shrapnel forging, First World War; 155-mm. high-explosive-shell forging, Second World War; specimen of charcoal pig iron, Union Iron Works, 1742; 12-inch cast-steel projectile, Spanish-American War. Rear row: 12-inch cast-steel shell, Spanish-American War; 155-mm-shell forging, Second World War; 9.2-inch-shell forging, First World War. At the left is a display of the company's products at the office of the Philadelphia Ordnance District. Below, forging for 155-mm. high-explosive shell; upper left, 155-mm. high-explosive shell ready for loading; center, cross section of shell, showing cavity; right, seamless-steel cylinder for storing gases.



Stringing Air Bases Across Africa

ON THE DESERT

Somewhere in Africa an awed native (right) watches a strange mechanical bird wing its way overhead. At the left is an air base in process of construction, mainly with African labor. Most of the structures are of the prefabricated type and were shipped knocked down, accompanied by blueprints showing how to erect them quickly with bolts. The mechanical facilities sent abroad to build the bases and to equip the shops included portable air compressors and small pneumatic tools for the work of assembling and maintaining planes.

ON AUGUST 18, 1941, President Roosevelt asked Pan American Airways to lay out a new air route from the United States to Africa and thence across that continent to the Middle East and to set up a "ferry" service for delivering military planes overseas in fulfillment of the terms of the Lend-Lease agreement. He requested that the aerial highway be placed in operation as quickly as possible. Although it was conceded to be a job that would take three to five years under normal conditions, Pan American had bases and airports set up and planes flying the route in just 61 days!

Details of this titanic accomplishment cannot be told until the war ends, but the bare fact that it was done ranks it among the miracle feats performed by private concerns in furtherance of the war effort. Inasmuch as it was primarily a military operation, it may seem strange that it was assigned to a commercial air line. Actually, this was the logical course for two reasons. We were not in the war at the time, so our uniformed personnel could not be put on the job in many places. Moreover, Pan American Airways was the best qualified agency to do the work, having previously laid out and operated 75,000 miles of air lanes to and through South America, across the Atlantic and Pacific oceans, and to Alaska.

Had there been no first World War, there might not now be a Pan American Airways to serve the United Nations. Juan Trippe, founder and president of the aerial transport system that now spreads its wings over the world, was a student at Yale University in 1917. He joined the navy and learned to fly, and that aroused his interest in aerial transportation. He established his first commercial airline on Long Island in 1923 and served as manager, pilot, and repairman for six planes. In June, 1927, he organized Pan American Airways and set up offices in two rooms of a New York building. Four months later the first load of international mail was flown from Key West, Fla., to Havana, Cuba, across 90 miles of water. During the intervening fifteen years, the growth of the organization has been spectacular. In 1941 the system's planes flew 24,358,346 miles over 98,582 miles of route and carried 375,732 passengers.

The ferry route across Africa had first to be built on paper. A group of the line's specialists moved some desks and chairs into one big room in New York and just about lived there until the job was laid out. This involved working out the engineering details, gathering together the personnel required for the construction, and arranging to transport the men to South America and Africa along with all the machinery and tools they would need, plus housing accommodations, food, clothing, medicine, and such incidentals as cooking utensils, dental facilities, and laundry equipment. In short, everything had to be provided, for most of the work was to be carried on far from the outposts of civilization. All told, 10,000 separate items were on the manifest. So complete were the plans that even recreation rooms and libraries were furnished, with the latest books and periodicals supplied regularly by plane from America. Wells had to be drilled for drinking water, sewage systems installed, and measures taken to control mosquitoes and other pests.

Within six weeks 15,000 tons of supplies were unloaded at African docks and started across country to various inland points where the airplane bases were to be established. The original working force consisted of 1,200 men, including experts on every phase of the operations involved, as well as skilled men in various lines and common laborers. Modern machinery aided them in carving airfields out of the jungles, but human muscles also did much of the work. At one stage 7,000 natives were employed, most of them moving dirt a basketful at a time. Prior to the time Pan American took over, the British had done some work on the bases, but it was little more than a good start. The British were handicapped by lack of funds, machinery, and planes, but did a creditable job with what they had at hand.

Although planes were flying over the trans-Atlantic and trans-African route two months after work began, a great deal remained to be done at the various bases, and activities are still being carried on. More than 100,000 tons of supplies have been delivered to them to date, and Pan American still has a sizeable personnel there, the exact number being a military secret. Consistent with the High Command's plans of limiting service into combat zones to the military as soon as possible, the army is taking over on October 31—the date of expiration of Pan American's contract for operating the line. Many of Pan American's key men on it have already accepted army commissions and expect to continue at their posts in running this gigantic aerial transport and ferry service.

High Flying

HIGH-ALTITUDE military flying has two general effects upon the human body. One is identical with that encountered by workers in compressed-air atmospheres, while the second and more common one is directly the reverse. Both conditions are simulated on the ground by means of low-pressure and high-pressure chambers for the purpose of studying the reactions of men training for aviation.

The average human being can breathe fairly comfortably at altitudes up to 15,000 feet if he is not exerting himself physically. Beyond that height the atmosphere is too "thin" for the lungs to obtain their required supply of oxygen without accelerated and labored respiration. Engines experience the same difficulty and are made to function normally or even supernormally by supercharging—that is, by feeding them air under pressure. Similar measures are adopted for persons, either by putting interior airplane spaces under pressure or by providing individual supplies of oxygen or oxygen-helium mixtures from tanks.

At an elevation of 35,000 feet the atmosphere is only one-fifth as dense as it is at sea level, and at 50,000 feet the proportion falls to one-ninth. Experience shows that the lungs approach the starvation point at 45,000 feet even when pure oxygen is furnished for breathing, and there is danger of fainting. The suddenness of the rise into rarified atmosphere has a bearing upon the physiological consequence, and the climbing rate of modern fighting craft is growing all the while. For example, it is claimed that the German *F.W. 190* can ascend at the rate of 3,000 feet a minute for the first 15,000 feet. Such a rapid change in atmospheric consistency imposes a stress upon the airmen akin to that experienced by divers and caisson workers when they come out of "high air" into normal atmospheric pressure. The blood stream and body tissues are unable to rid themselves quickly enough of the nitrogen in the air breathed at higher pressure, and these bubbles expand to proportions that cause pain and, in extreme cases, stoppages that endanger life. Fortunately, the change in pressure for every 1,000 feet of rise is equivalent to that for about 1 foot of rise in water. Consequently, the problem is less serious, but it is present and will become greater as the climbing capacity of planes increases.

When a member of a plane crew is forced to bail out at a high altitude, he is in a critical situation as regards his air supply. In the range above 18,000 feet he cannot get sufficient oxygen from the atmosphere to endure for more than a few minutes. If he jumps at an elevation of 35,000 feet and opens his parachute immediately, it will take him around ten minutes to reach the relatively safe level of 18,000 feet, the rate of descent varying from 2,400 to 1,200 feet per minute, depending upon the type of parachute and the initial height. This far exceeds the limit of safety, and airmen are therefore trained to delay opening the parachute until at the 18,000-foot level. In the case just cited, this would take some 90 seconds, and there would be danger of the man losing consciousness before the time came to pull the rip cord. Obviously, there is need for mental alertness under such conditions, and to help flyers retain their faculties under these trying circumstances they are now being provided with small portable oxygen sets. So fortified, they can breathe with some degree of normality during the critical plummet-like fall and preserve the keenness of mind that is essential to gauging just when it is safe to open the parachute.

Wartime Eating

WE HAVE long been called an overfed nation. Perhaps we are, but rationing and shortages bid fair to assert their corrective influences shortly. So far our principal worries have been over such trifling matters as second cups of coffee. The staple items of our diet have scarcely been touched, although certain cuts of meat are harder to obtain and prices of innumerable foods have advanced so sharply that many prudent housewives now curtail their purchases of them. Nevertheless, most of us are still using the same notches in our belts as formerly. We have a long way to go before we reach the levels of Great Britain, Germany, and Italy, where meat rations are measured in ounces per week, and where fats, fresh eggs, citrus fruits, and other standard foodstuffs have all but disappeared. As we approach meatless days and coffeeless meals, it is comforting to know that our national health is in no great danger of being impaired. Only recently an authoritative report on the physical and mental condition of the British people informed us that they have not suffered. In fact, the death rate from natural causes has decreased since the war began.

On the whole, American laborers, both skilled and unskilled, are eating more and better food than usual for the simple reason that they have more money with which to buy it. Realizing that good health among workers means the loss of fewer hours of production and better public morale, the Government is concerning itself with what goes on family tables and into wage earners' lunch boxes. Home economists and dietitians are educating housewives along these lines. The general prescription for workers is to eat three nutritious meals a day to retain strength and fitness, and little is said about stopping before the appetite is fully appeased. It is stressed, however, that meals should be balanced, with plenty of fruit and vegetables and not too much starch. Instead of the traditional meat sandwich and pie or cake in the lunch box, the experts are advocating eggs, cheese, and even hot stews carried in vacuum containers.

Gas and electric companies and makers of cooking utensils are aiding in this educational program, with demonstrations of various kinds of meals to suit a wide range of budgets and to evade shortages of certain foods. They are also teaching women how to buy and to store foods and how to prepare them so that they will be both tasty and nutritious.

Log of Our War Economy

THE following paragraphs contain significant bits of information culled from official press releases sent out by the War Production Board.

SEPTEMBER 21—Fifty-one per cent of the weekly ticket sale for bus and railroad travel takes place on Friday, Saturday, and Sunday. Saturday is the heaviest day, with 21 per cent. To shift travel to mid-week, it is desired to cut the week-end sale to 43 per cent of the total. Based on present figures, this represents a drop of 8 per cent.

SEPTEMBER 22—The War Production Board urged businessmen to consult regional or field offices and not to go to Washington unless they have to. There are twelve regional and 127 field offices, and these can handle most matters quicker than the Washington office which is overloaded because of so many visitors.

SEPTEMBER 24—Until December 23, a maximum of 6 pounds of iron and steel may be used on a casket as joining hardware. After that date the permissible amount will be 4 pounds. Iron or steel handles are prohibited after manufacturers have exhausted the supply they now have on hand.

A ration-coupon banking system similar to that in England will be adopted by the OPA. About 130,000,000 sugar-rationing stamps and 150,000,000 gasoline-rationing stamps are now handled monthly. Under the system merchants will deposit their stamps in a bank and will issue vouchers against them, just as is done with money. The plan will be given a 6-week test in the Albany-Schenectady-Troy area of New York before being made nation-wide.

SEPTEMBER 25—All citizens have been asked to report old iron or steel structures that might be converted into scrap. Typical examples are abandoned bridges, buildings, railroad rails, tanks, and sunken ships. Upon being informed of their existence, the Government will approach their owners. Where the cost of dismantling is greater than the return, financing may be arranged.

ODT Director Joseph B. Eastman declined to sanction the scrapping of 800 discarded cars from New York's dismantled elevated railroad, stating that they are more valuable as reserve transportation units. Two hundred such cars have already been assigned to service.

SEPTEMBER 30—Small manufacturers who cannot qualify for loans from banks can get them from the $150,000,000 fund of the Smaller War Plants Corporation if the money will help to win the war, according to an official statement. It is declared that the corporation does not intend to handle the fund loosely, but that it will not require gilt-edge security from the borrower if he can use the loan to advantage in aiding our fighting forces.

OCTOBER 1—Offices of the WPB, both in Washington and in the field, have gone on a 6-day week for the duration. Employees who work Saturday afternoons will be given four hours off during the following week.

OCTOBER 2—Auto graveyards, of which there are 20,000 in the country, are now providing about 20 per cent of all our iron and steel scrap. Approximately 400,000 cars pass through the yards every month, as compared with 150,000 in peacetime. The average automobile yields 1,500 pounds of iron and steel, 30 pounds of copper, 6 pounds of aluminum, and 50 pounds of rubber. In addition, a great many usable parts are saved and will soon become the chief source of supply of replacement parts for cars now on the road.

By using fewer and simpler milk cans, the nation's dairies will free 18,000 tons of steel annually for war production.

The substitution of silver for copper in electrical equipment has saved 12,000 tons of copper during the past few months.

OCTOBER 6—New Jersey became the first state to stagger work and school hours by official governmental authority. A coordinator of transportation, appointed by Gov. Charles Edison, ordered schools in cities of the state to adopt new opening and closing hours—in most cases one hour later than those previously in effect. Business houses in one section of Newark were instructed not to open before 10 a.m., and not to close before 6 p.m. Six Newark concerns employing large office forces were given new opening and closing hours to stagger them with changes of shifts at war-production plants.

OCTOBER 8—After December 1, the amount of steel in a full-sized bedspring will be reduced to 15 pounds, as compared with from 60 to 100 pounds, and that in a twin or single bedspring to 9 pounds. The new order is expected to save 15,000 tons of steel annually.

OCTOBER 11—Simplification of forms used by WPB to obtain information from businessmen has been effected and will save 150,000 firms much time. A committee assigned to this task has eliminated 120 forms and simplified 132 others. Henceforth all forms will be made to fit a standard-carriage typewriter.

The WPB functions to save critical war materials even in far-off Australia. By lighting airports under Gen. Douglas MacArthur's control with high-voltage electrical systems instead of the low-voltage lines originally requested, it is estimated that 500,000 pounds of copper, lead, steel, and other materials will be conserved.

OCTOBER 12—Private industries and governmental agencies were urged to utilize water carriers for freight shipments wherever possible so as to ease the burden on the railroads. Railroad freight traffic is running 30 per cent ahead of 1941, and is still increasing. Expansion of facilities is difficult because of shortages of materials for new freight cars and locomotives.

In an effort to develop new steel alloys that will require smaller amounts of certain alloying metals than have been used in the past, WPB has authorized seventeen steel producers to ship experimental quantities of emergency steels to laboratories or manufacturers in the fourth quarter of the year. The six most important alloying metals are nickel, chromium, manganese, tungsten, vanadium, and molybdenum. In normal times most of our supply of all of these, save molybdenum, comes from abroad. The first three were almost wholly imported prior to Pearl Harbor. Since 1940, the demand for these metals has increased 240 per cent. Every effort is being made to develop new sources of supply, both at home and in countries not under Axis domination. For example, the United States chromium production is 250 times greater than in 1940. Despite the progress that has been made, shortages of certain metals are imminent in the face of rising consumption. Hence the experimentation with new alloys.

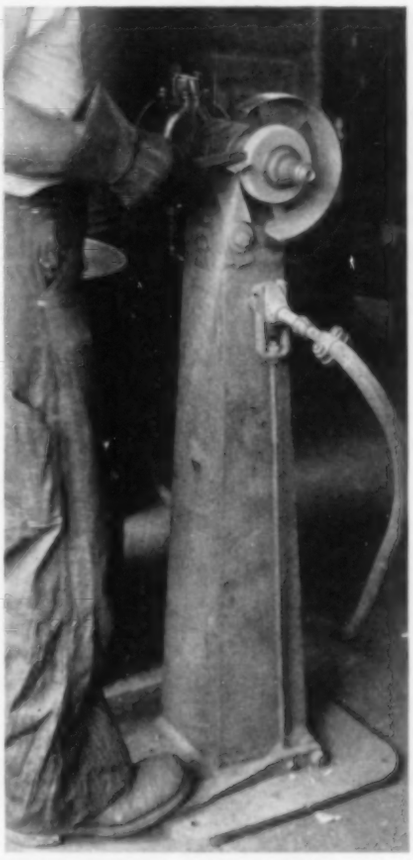
OCTOBER 13—The tin-can-salvage program has been extended throughout the country, and housewives everywhere are asked to prepare cans for collection, to be announced locally. Preparation consists of removing the label, washing the can, cutting off the ends and inserting them in the can, and then flattening it. It is estimated that there are 1,000,000 tons of tin cans in the country. Practically all those collected will go to detinning plants, where the tin will be recovered and the steel-sheet base will be saved for use in steel mills. In the southwestern part of the country the cans are sent to copper mines, where they are placed in the mine water to precipitate the copper carried in solution. By this method, every 100 pounds of tin cans is made to produce 150 pounds of copper.

OCTOBER 19—Housewives are being urged to reduce their purchases of canned goods by one can each week. It is estimated that this would bring about annual savings of 190,000 tons of steel, 2,600 tons of tin, and 77 tons of rubber. Purchased or home-grown fresh vegetables or fruits and home-canned foods are suggested as replacements for the can a week that is not bought.

Sparks Reveal Identity of Alloy Steel

BECAUSE virtually all ferrous metals produce characteristic sparks when they are ground with an abrasive, the spark test offers a simple, quick, and inexpensive means of identifying alloy-steel scrap in industrial plants. Owing to the shortage of most of the alloying elements and the emphasis that is being placed on their conservation, spark-testing assumes added importance at this time. True, it is not nearly so reliable as chemical analysis and can be substituted for it only to a limited extent, but it is the next-best method of identification, and is less costly. In a scrap yard, which gathers metal from many sources, there are naturally alloys of many kinds, and the problem of segregating them is complex. In the average industrial plant, on the other hand, there are fewer alloys to classify and the salvage department knows in advance just what to look for. This reduces the chance of error and makes spark-testing adequate in most instances. The method is not new, having been used in steel mills and various industrial establishments for many years. In the case of the former, the flow of material is ordinarily great enough to permit one man to devote all his time to the work, in which he becomes highly skilled. Conditions are less favorable in the average industrial plant, but good results can, nevertheless, be achieved.

The only equipment required for spark-testing is a power-driven grinding wheel, a pair of goggles, and, under circumstances, a set of standard samples of steels of known composition. If the scrap is in large pieces, a portable grinder is most suitable. But in the average plant most alloy steel is in the form of small machine tools, and the scrap is normally transported to a central point for testing. In such cases a stationary grinder best answers the requirements. An air-operated grinder, with foot control, is illustrated. Regardless of the type of grinder employed, it is desirable that the wheel have a peripheral speed of at least 4,000 feet per minute so as to produce a spark of suitable length and brightness. Almost any standard wheel is satisfactory, but it is advisable to use the same type all the time to obtain the same sparking conditions. It need hardly be stated that direct sunlight should be excluded, although it is not necessary to have a dark room to make the sparks clearly visible.



SPARK-TESTING

This equipment is used by the salvage department of a large machinery-manufacturing plant. The Ingersoll-Rand air-operated pedestal grinder has a foot control that leaves the operator's hands free for his work.

An individual spark consists of a main shaft or carrier line which may end in an arrow-like point, fork into several lines, or terminate in a burst. Large numbers of these sparks, alike except for size, make up a spark stream, and it is difficult to observe the characteristics of any one of them. Details can be seen better if the grinding pressure is reduced, for then there will be fewer overlapping sparks. At times a single spark clings to the wheel for an instant before it is thrown off and stands out plainly because there is no background of sparks to obscure the details.

The principal alloying elements in industrial steels are carbon, manganese, nickel, chromium, molybdenum, tungsten, and vanadium. All have sparking characteristics that can be distinguished by a person with moderate experience in spark-testing. In the great majority of plants, however, most of the tool steel used is either a high-carbon type or one that contains varying quantities of tungsten or molybdenum. These can be readily identified simply by observing the color and the volume of the sparks they emit. Machine steel, with 0.20 per cent or more of carbon, produces a heavy spark stream, molybdenum steel a lesser volume, and tungsten steel still less.

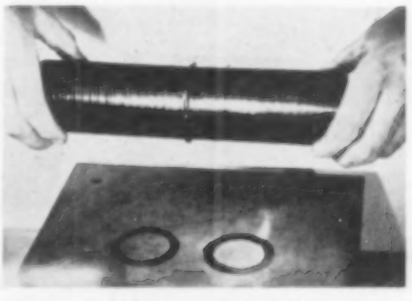
It is not within the scope of this article to discuss the details of the sparks given off by the various alloys. Those that are interested in pursuing the subject further are referred to an article in *The Iron Age* for April 16, 1942, by L. P. Tarasov.

Plastic Instead of Iron for Small-Diameter Pipe

AS a substitute for metal pipe of 2 inches outside diameter or less, The Dow Chemical Company is making a plastic pipe of a new thermoplastic resin called Saran. The latter is odorless, tasteless, and nontoxic, and produces a nonin-flammable material of exceptional toughness and strength, qualities which it is said to retain with age. In addition to these properties, Saran pipe is claimed to be nonscaling and resistant to abrasion, to heat up to 175°F., freezing, moisture, chemicals, and most solvents. It can be cut with a wood or hack saw; can be welded, heated, and bent; and can be threaded with ordinary iron-pipe dies. Unless the latter are sharp, it is advisable in the case of the larger sizes to insert a close-fitting plug in the end to be threaded to guard against compression and resultant shallow threads. Fittings for the new plastic pipe other than standard flanges are not available at present, but the company is engaged in making molds for flanges with threaded ells, tees, and couplings. Tabular data concerning pipe sizes, weights, bursting pressures, etc., will be furnished upon request.

HEATING

In welding Saran pipe, the pieces are placed on a hot plate, as shown; heated to a temperature of 350 to 400°F.; and left there until the material at the point of contact begins to melt.



WELDING

At the proper stage the pipe ends are pressed together firmly and allowed to cool for ten seconds. The entire job takes less than a minute, and the weld is said to be stronger than the pipe.

Industrial Notes

For tools subjected to rough treatment and shock, the Jessop Steel Company has developed a water-hardening steel known as Type RT. When heat-treated, sections less than ¾ inch in size will harden throughout, while those 1½ inches in diameter will have a tough core and a hard outside layer approximately ¼ inch thick.

From South Africa comes the report that a gold reef lost 40 years ago in the old workings of the Southern Van Ryn Mine in the Klerksdorp district has been rediscovered. According to an official of the mine, the ore was found hanging like icicles from jagged rocks throughout a distance of 300 feet, and samples containing 70 per cent pure gold could in some cases be assayed without the usual reduction.

Under the trade name of Magnaglo and Zyglo, the Magnaflux Corporation has introduced two new fluorescent substances for the detection of flaws in metals. Magnaglo is in paste form and is used in connection with the company's Magnaflux equipment on parts of magnetized or magnetic metals. Zyglo is a liquid and is applied to nonferrous metals to disclose defects that extend well below the surface. (Scratches or minor surface irregularities are not shown.) Both glow in black light.

Anything that will add mileage to automobile tires deserves attention, and car owners will be interested to hear what Transmotive Laboratories has to say about the Prolatex Rubber Saving System that it has developed. The preservative has a soya-bean-oil base compounded

with several well-known substances that check the deterioration of rubber. It is a low-viscosity penetrant that is absorbed quickly and fills the pores, cracks, minor cuts, and abrasions and seals the outside surfaces against oil, grease, gas, and air, as well as the harmful rays of the sun. Application is effected with the tires in place by immersion in a special dipping tank, permitting them, together with the spare, to be treated in from 20 to 30 minutes at a cost of about 50 cents a tire. The system is suitable for all kinds of rubber products.

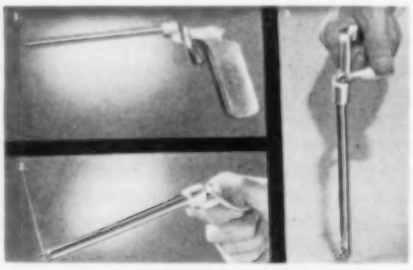
So that leather-faced and leather industrial gloves may give the longest possible wear, J. T. Reed & Company, Hancock Square, Charlestown, Mass., is prepared to clean, repair, and sterilize them at charges varying from 12 to 18 cents a pair for cleaning and 10 to 15 cents a glove for mending.

National Forge & Ordnance Company of Irvine, Pa., recently received its fourth award within a year for excellence of production. Its initial award was the Navy Ordnance "E" pennant in November, 1941. This was followed by the All Navy "E" pennant last April. Then came the first white star in May for maintenance of award standards for six months. The most recent award was the Army-Navy flag, and as the white star had previously been won it was added to the flag at the time of presentation.

Of considerable interest to users of cutting tools is the recent announcement by the Wright Aeronautical Corporation that they can avail themselves of its newly developed precision grinding and honing process which, according to the vice-president of the company, measurably lengthens the period between regrindings and, consequently, service life. It is pointed out, by way of example, that where a tool formerly cut thirteen gears before regrinding it now cuts from 200 to 500, while another that had to be reground after each operation on a large part of a Cyclone engine can repeat the work 28 times without going back to the shop for reconditioning.

A recent contribution of tremendous value to aviation has been made by Dr. Waldo Kliever of the Minneapolis-Honeywell Regulator Company. Doctor Kliever has invented an electrical instrument that measures the thickness of ice forming on airplane wings and turns on the pneumatic de-icing system before it is too late for it to be effective. The latter consists of rubber "boots" on the edges of wings and other plane surfaces, on wheel struts, etc. These elastic members are made to pulsate by inflating them with compressed air and deflating them, thus breaking up the ice and ridding a machine of the overweight that might send it crashing to earth.

A tool that serves both as a wire cutter and a retriever of small parts such as nuts, bolts, washers, etc., is being distributed by the Pack-Rite Machine Corporation. The device is in the shape of a pistol with a long, slender barrel and with a trigger that operates hardened-steel cutting edges through a rod inside the barrel. With a leverage ratio of 15 to 1, slight down



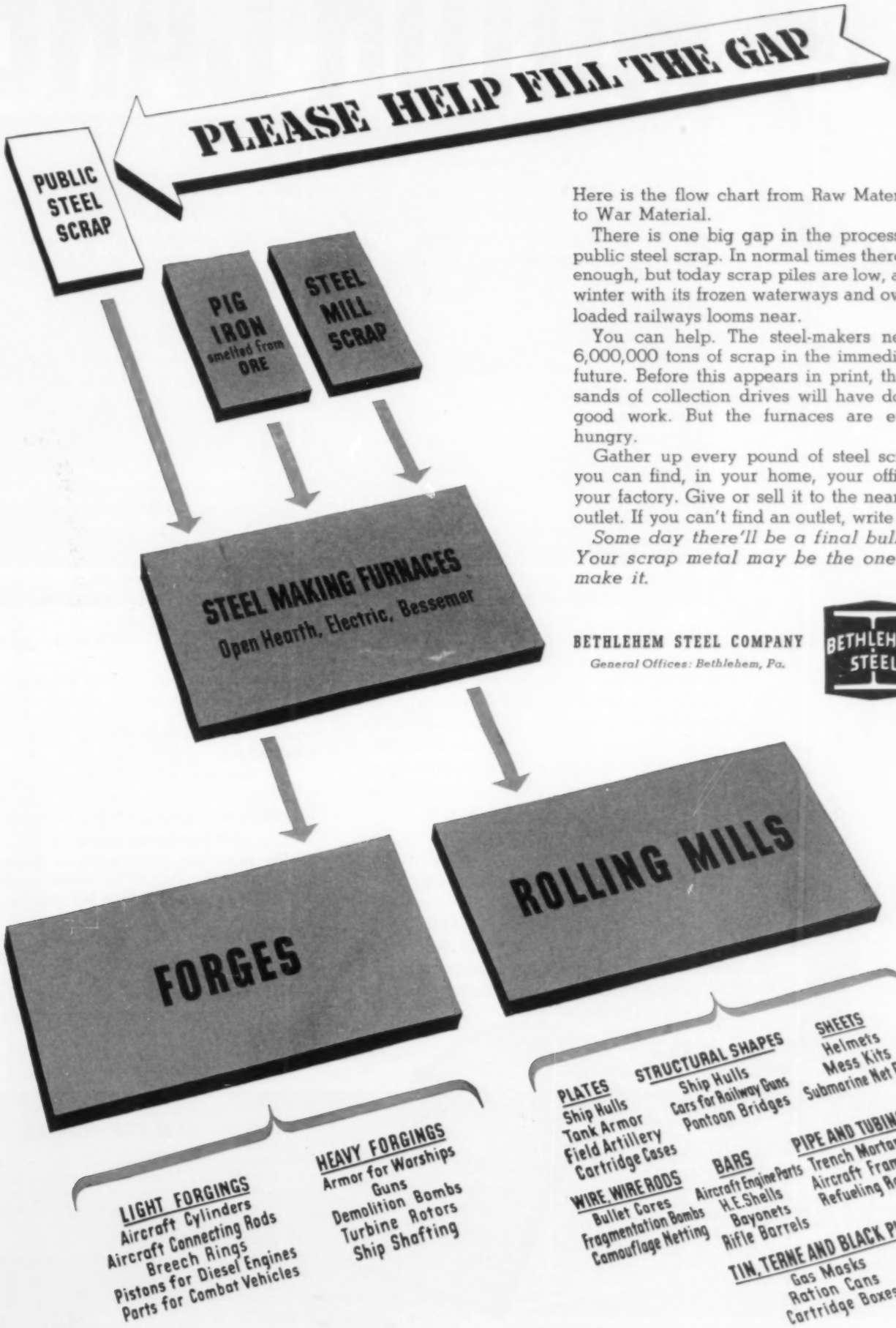
HANDY GADGET

The tool (1) and how it is handled in cutting a wire (2) and in retrieving a nut (3).

pressure of the thumb on the trigger is sufficient to snip a wire or to pick up a nut or the like that has dropped into an inaccessible place. The Alpert Long-Nose Cutter-Retriever is light and flat so that it can be carried conveniently in a belt or holster.

By a process known in automobile manufacture as Die-Typing, the Die-Typing Company is prepared to produce dies in quantity for hot-forging work at a cost per unit that is said to be considerably less than that when manufactured by the customary machine method. The line includes complete dies for small parts and inserts for die blocks for the production of comparatively large parts. The process involves the making of a female master die by the conventional method, from which a male master die is forged from a block of hot steel. It is claimed that the latter is good for as many as 300 production dies. If more are needed, additional male master dies can be made from the original female master die.

Chromium, one of the essential war metals, is promised us in abundance here at home through efforts of the U. S. Bureau of Mines to extract the mineral from the low-grade ores of which we have numerous deposits. In the past we have depended upon New Caledonia, India, Turkey, the Philippines, and other foreign countries for the 600,000 tons we consumed annually; but with the imports cut off, we have seriously turned our attention to our own sources of supply. These are high in iron and low in carbon content, and, until of late, it has been next to impossible to separate them so as to obtain a ratio of at least three parts chromium to one part iron, which is necessary for the making of satisfactory alloys. By the process developed by the Department of Mines the ratio has been increased from less than 2 to 1 to as much as 30-40 to 1.



Here is the flow chart from Raw Material to War Material.

There is one big gap in the process—public steel scrap. In normal times there is enough, but today scrap piles are low, and winter with its frozen waterways and overloaded railways looms near.

You can help. The steel-makers need 6,000,000 tons of scrap in the immediate future. Before this appears in print, thousands of collection drives will have done good work. But the furnaces are ever hungry.

Gather up every pound of steel scrap you can find, in your home, your office, your factory. Give or sell it to the nearest outlet. If you can't find an outlet, write us.

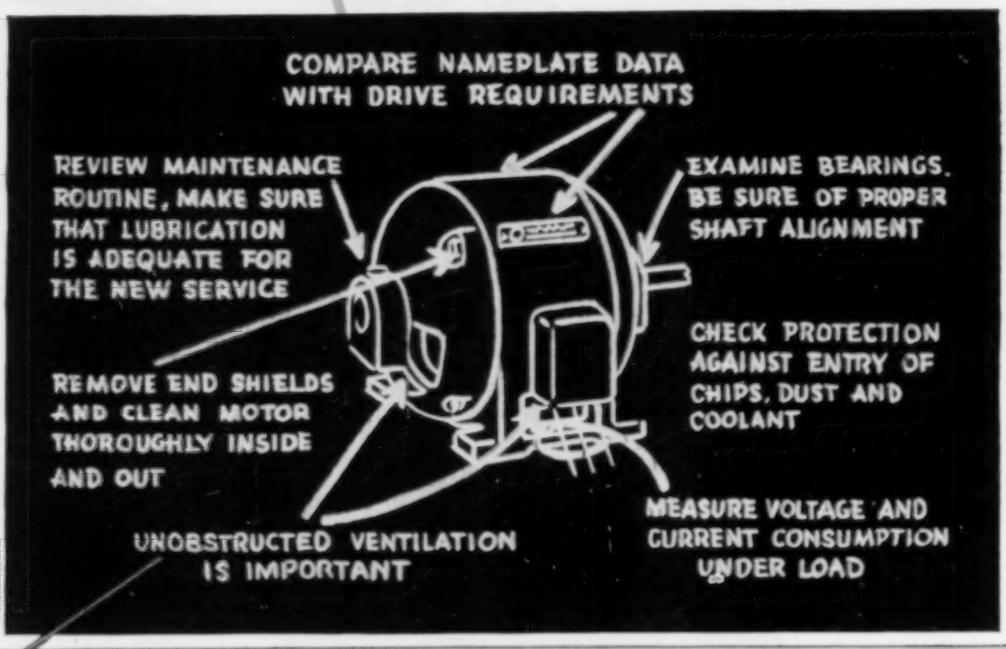
Some day there'll be a final bullet. Your scrap metal may be the one to make it.

BETHLEHEM STEEL COMPANY

General Offices: Bethlehem, Pa.

BETHLEHEM STEEL

IT'S TIME TO BE A CRANK ABOUT MOTOR CARE


COMPARE NAMEPLATE DATA WITH DRIVE REQUIREMENTS
REVIEW MAINTENANCE ROUTINE, MAKE SURE THAT LUBRICATION IS ADEQUATE FOR THE NEW SERVICE
EXAMINE BEARINGS. BE SURE OF PROPER SHAFT ALIGNMENT
CHECK PROTECTION AGAINST ENTRY OF CHIPS, DUST AND COOLANT
REMOVE END SHIELDS AND CLEAN MOTOR THOROUGHLY INSIDE AND OUT
UNOBSTRUCTED VENTILATION IS IMPORTANT
MEASURE VOLTAGE AND CURRENT CONSUMPTION UNDER LOAD

protect your production with this maintenance plan

Planned motor maintenance, keyed to today's loads and conditions, saves vital hours by forestalling future breakdowns and delay. In replacing hit-or-miss motor servicing with a regular schedule of trouble-*prevention*, you'll find real help in the new G-E publication, "How to Care for Motors."

The check list (right) tells what to do. This book tells how to do it, using well-proved methods that save time and help assure long-lasting motor service.

And, of course, your local G-E Motor Representative is always ready to aid you in putting these suggestions into practice, or in getting the new motors you may need for essential wartime projects.

The Navy "E", for Excellence, has been awarded to 92,780 General Electric employees in six plants manufacturing naval equipment.

1 Make sure that motors are selected to *match the job*. Install motors so they are properly aligned with the driven load and are easily accessible for regular inspection.

See "How to Care for Motors"

2 Keep motors free from dust and dirt. Establish a definite cleaning schedule.

See "How to Care for Motors"

3 Be sure that lubrication is frequent enough to take care of increased production. See that employees are instructed as to proper methods.

See "How to Care for Motors"

4 A general overhauling of hard-worked motors will add years to their life. If your motors haven't had an overhaul in the last year, try to arrange your schedule to permit one.

See "How to Care for Motors"

General Electric, Sec. G750-179
Schenectady, N. Y.

Yes, send me a copy of "How to Care for Motors," GEA-2856A.

Name.....

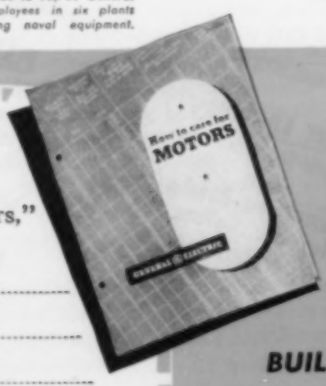
Title.....

Company.....

Address.....

City.....State.....

8090



HOW TO CARE FOR MOTORS

Every supervisor and maintenance man will find this book of value . . . it tells what to do to get the most out of motors, old or new. If you're setting up a maintenance program to keep up with today's unprecedented demands, or if you're "switching" motors from one job to another, or equipping machines with new motors, you'll find this booklet of helpful motor facts will save you time. Write for a copy.

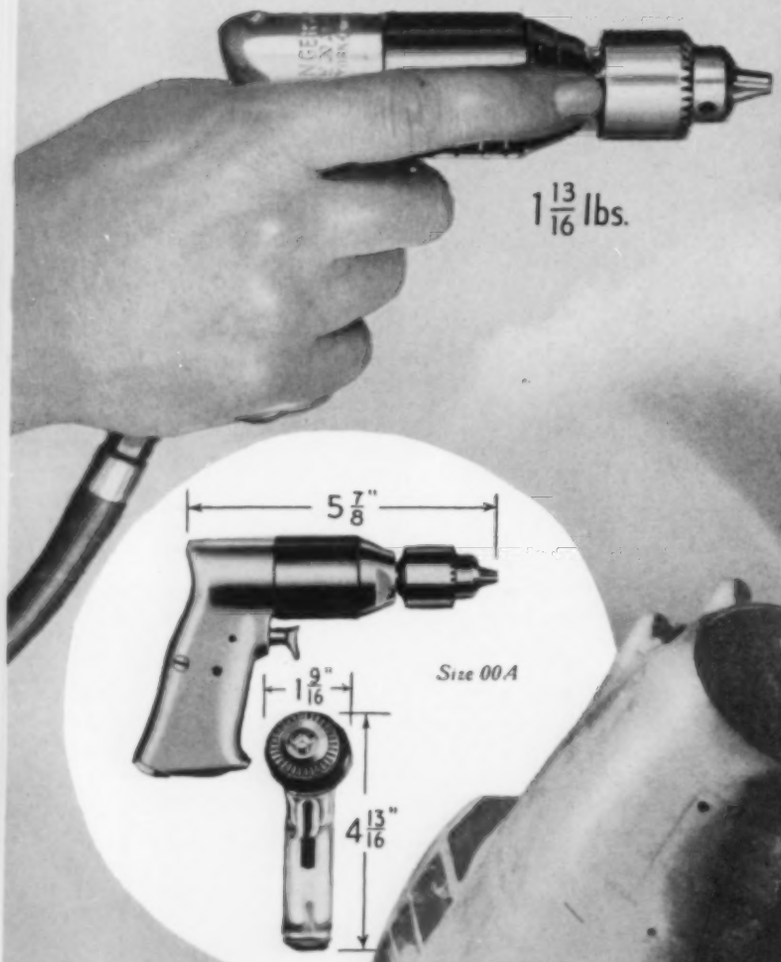
BUILDER OF TRI CLAD MOTORS

GENERAL ELECTRIC

When PRODUCTION DEMANDS put a strain on Compressors...
...Keep them on the job with Stable
SHELL COMPRESSA OIL
HERE'S why you'll find Shell Compressa Oil doing an outstanding lubrication job day after day—
1. It is highly stable under severe operating conditions.
2. Does not break down at high compression temperatures . . . prevents excessive formation of carbon deposits. Retains its lubrication qualities.
3. Helps prevent ring sticking and blow-by . . . keeps discharge valves working freely.
4. Reduces wear on all sliding and rotating parts.
5. Has high resistance to emulsification.
6. Assures low oil consumption by effectively sealing pistons.
Is your compressor oil turning in this kind of performance? Consistently? Be sure. Call in your Shell man today!
SHELL

Reporting for Active Duty!

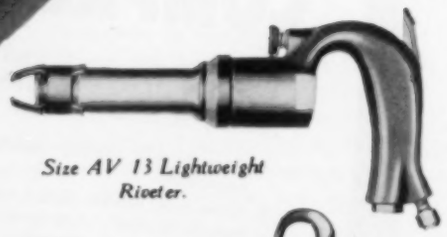
THE LIGHTEST, SMALLEST, SHORTEST AND MOST COMPACT DRILL IN ITS POWER CLASS TODAY



The new Ingersoll-Rand Size 00A lightweight pneumatic drill is ready to do its part on the production lines, particularly those in the aircraft industry.

- Powered by an efficient "Multi-Vane" Air Motor.
- Built-in speed regulator can be set for desired performance.
- Sturdily constructed for 3-shift endurance.
- Split-second throttle action permits quick, accurate hole-starting.
- Lubrication is provided by a built-in automatic oiler.
- Light weight means easier handling . . . less fatigue . . . increased production.
- The combination of these features makes the 00A drill an ideal tool for women operators.

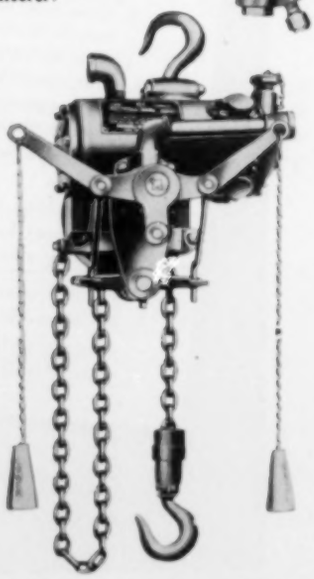
Size 00A



Size AV 13 Lightweight Riveter.

Size 00 Lightweight "Multi-Vane" Grinder. Weighs only 1¼ lbs.

Size AVC-10 Lightweight Riveter.



AIR-BLOC Hoist—for loads up to 700 lbs Weighs only 75 lbs.

A complete line of I-R pneumatic tools is available for—Riveting—Drilling—Grinding—Chipping and Hoisting.

Ingersoll-Rand

11 BROADWAY, NEW YORK, N. Y.

8-192

WE HAVE no bone to pick with expediters. They're welcome at our plant. In fact, we're glad to see them and make them comfortable as our guests. However, much as we enjoy their company, we do our best to make their presence unnecessary. Orders for France packings are accelerated by eliminating red tape, by fast scheduling, by a simplified follow-up system, by personal supervision, and —of course—by modern equipment working around the clock. Rarely can it be said France Manufacturing Company delivers too little or too late.

Send your expediters if you must though we'll get your orders out anyway, or bust—trying.

Naturally, war orders come first. But if you have a packing problem, we'll do our best to help you. Besides the 5000 lb. gas circulator packings for which we are well known, we make a complete line of packings for gas engines, gas or air compressors, and for stationary and marine steam engines.

PACKINGRAM

by E. A. FRANCE

PACKINGS FOR CHEMICAL PLANTS

The type and designs of packing supplied the Chemical Plants include our entire line. Many of them are used by other industries as well, but quite a few have been designed for and are used strictly by the Chemical Industry.

To state simply the many gases that France Packing has encountered would not do justice to the packing problems that we have solved. Air at 100 lbs. presents quite a different packing problem than air at 4000 lbs.; and likewise, ammonia at approximately 200 lbs. for refrigerating purposes requires packing of an entirely different design than the primary compressors and circulators of an Ammonia Plant that makes ammonia at pressures of 3100 lbs., 5150 lbs., or 15,000 lbs.

Packing for pure gases is not a difficult problem but mixed gases call for engineering ingenuity in the use of the relatively few materials available to withstand combinations of pressures, temperatures, inadequate or cut lubrication (if any), moisture and corrosion of many different agents. And these problems become more baffling because of secretive processes in which compressors are used and packings are required.

But France Manufacturing Company, when given an inkling of what is expected of a packing, can and does build a packing to solve the problem. Whether it is for Fluorine, Chlorine, Methanol, Helium, Butadiene, Ammonia or any of the hydro-carbon gases we apply the basic principles of packing seals with due respect for chemical effects, and create packings that show outstanding performance in their respective applications.

CAST IRON RINGS • SCUFF-PROOF CAST IRON RINGS • BRONZE RINGS • CARBON-BAKELITE RINGS • CARBON RINGS

Complete line of packing for all gases up to 15,000 lbs. pressure, as well as for superheated steam engines and gas engines.

FRANCE MFG. CO.

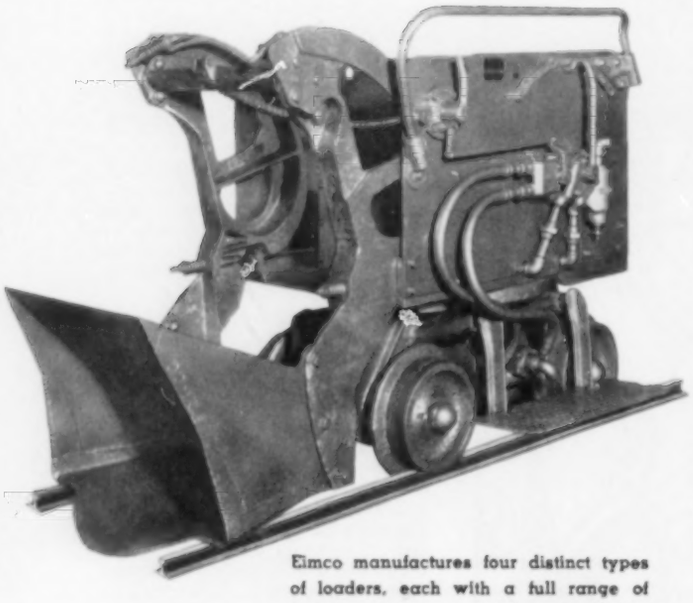
FRANCE MANUFACTURING COMPANY

Belgrade and Orthodox Streets • Philadelphia, Penna.

"Don't Take A Chance—Take FRANCE"

Eimco Loaders at

in production of strategic metals



Eimco manufactures four distinct types of loaders, each with a full range of bucket discharge heights, headroom heights, and track gauges. Above is illustrated the Eimco Model No. 21.

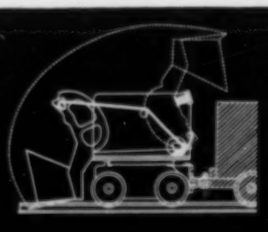
When Army and Navy officials requested operators of strategic metal mines to produce large quantities of ore, THE EIMCO LOADER was the one reputable machine on which mine operators could depend. Production figures at properties using the Loaders were so encouraging that now practically every progressive mine employs one or more EIMCO loaders. EIMCO loaders are self propelled, backward and forward and embody such features as: patented rocker arms, adjustable digging widths, two especially designed, powerful five cylinder air motors and many other features found in no other loaders of their type. Illustrated Bulletin No. 105 describing the EIMCO loaders and their many applications in modern mines and tunnels will be forwarded upon request.

To load cars quickly, evenly, and without spillage is characteristic of the Eimco Loader, and essential to strategic metal production.

This picture shows a loader in a shrinkage stope where Eimco Loaders have been able to maintain remarkable tonnage production.

OUR GUARANTEE

The inherent superiority of Eimco Loaders has been so thoroughly proved that every machine sold now carries a positive money-back guarantee that it will outlast and out-perform any other mucking machine of comparable size and type at any air pressure, and under any working condition.



EIMCO PATENTS

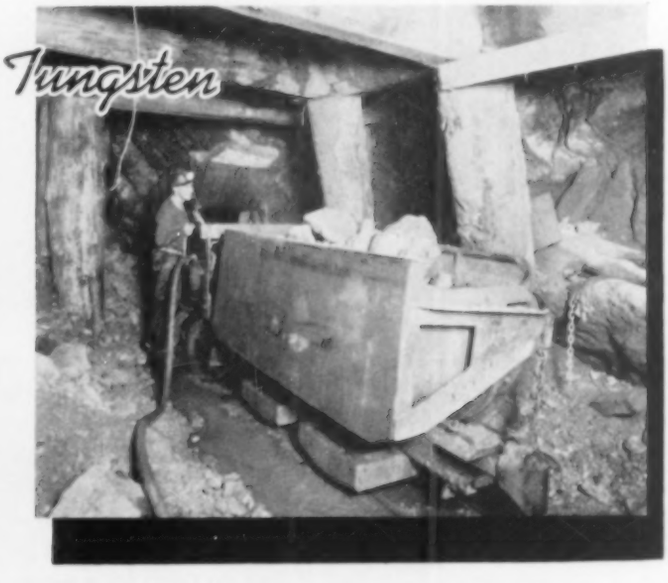
Give exclusive rights to the use of any rocker-arm profile other than a segment of a true circle and to the use of any rocker-arm which rolls on a supporting track or bed. No other known method for controlling the action of a mucking machine permits such simple sturdy construction or gives such high operating efficiency.

the front . . .

Eimco Loaders are the answer to stope and raise cleanup. Eimco No. 12 does it better than a ton a minute—don't bother with chutes.

Eimco Loaders are able to maintain your schedule regardless of the way the ore breaks—Eimco Loaders handle the big ones easily.

Mining Companies in our Allied Countries have found the Eimco Loader of essential importance in production—and the natives take to them.



Eimco No. 21 handles ore at better than two tons a minute. Eimco Loaders will load the longest cars—full—all the way back.

THE EIMCO CORPORATION

SALT LAKE CITY, UTAH, U.S.A.

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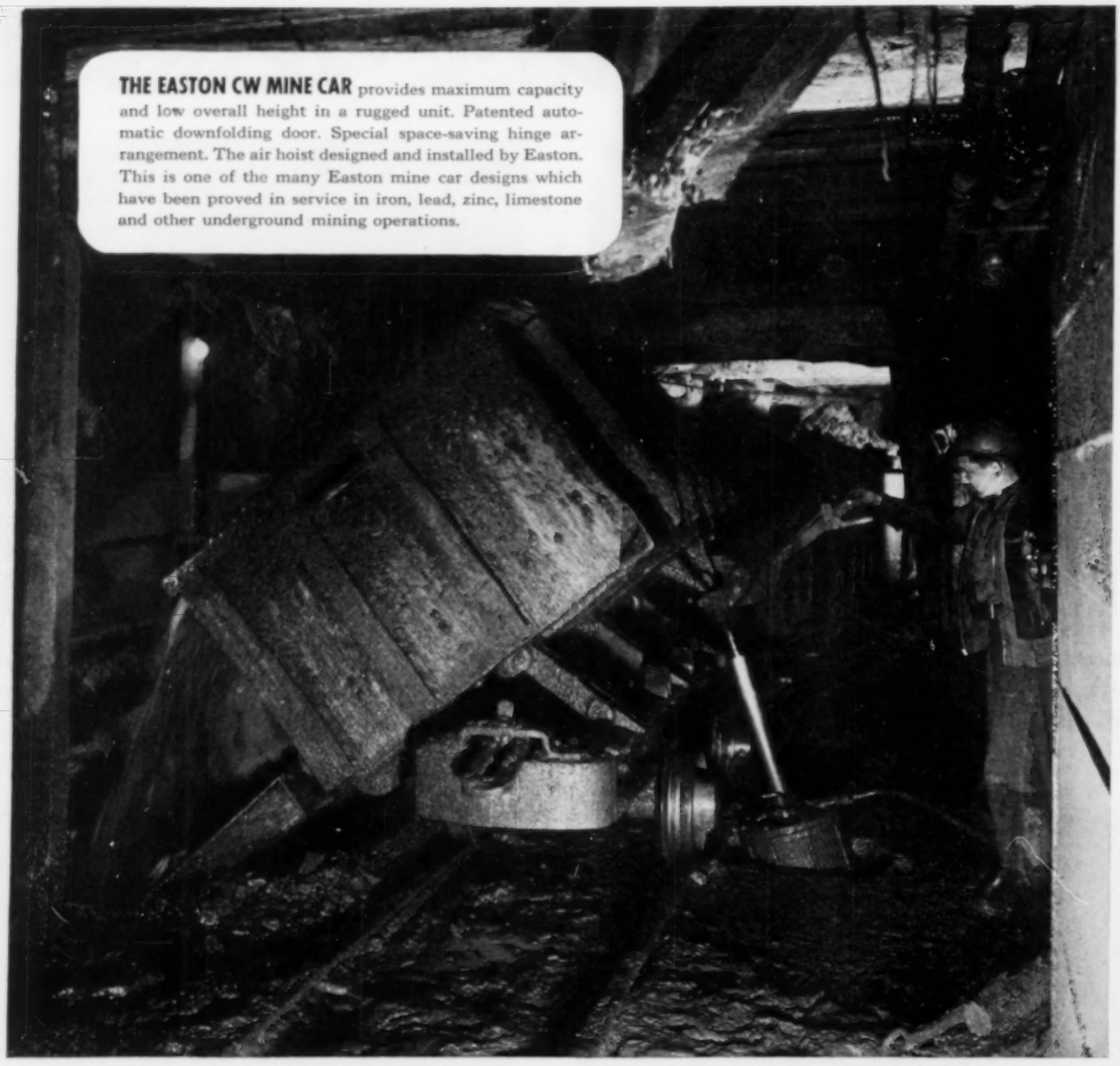
120 Broadway

CHICAGO,
111 W. Washington St.

EL PASO
Mills Bldg.

SACRAMENTO
1217 7th St.



THE EASTON CW MINE CAR provides maximum capacity and low overall height in a rugged unit. Patented automatic downfolding door. Special space-saving hinge arrangement. The air hoist designed and installed by Easton. This is one of the many Easton mine car designs which have been proved in service in iron, lead, zinc, limestone and other underground mining operations.

WET ORE IN A LOW, NARROW DRIFT

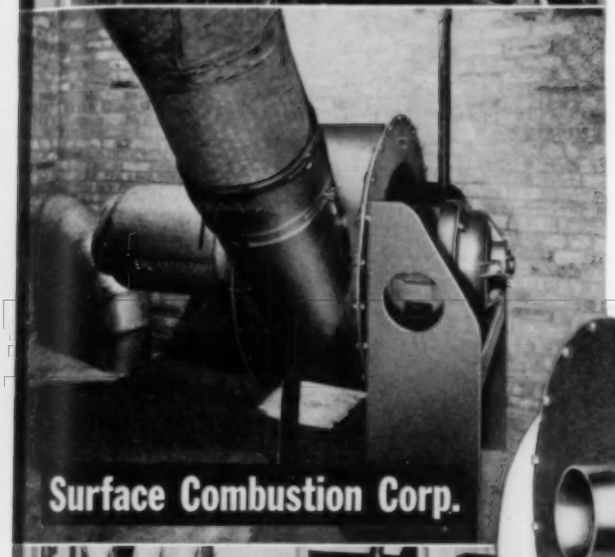
It's wet iron ore and it sticks like heavy mud! The haulage ways are so narrow that you flatten against the wall to let the cars roll by. Because of limited overhead clearance the cars are built as low as possible. And there's no room for a weakness anywhere when the container is bounced on the hoist to shake loose those tons of sticky ore. Easton CW Mine Cars have licked this tough job through months of triple-shift War Production.

Duplicated on no other installation, the Easton CW Car is a product of Easton haulage engineering — in this case to meet the specific conditions of wet ore and narrow drifts. *Your* haulage problem, in open pit or underground mine, in quarry, or in factory, *is different, too.* To help you to achieve your desired capacity at lowest cost per ton in any material handling operation Easton Engineers are at your service. Write to Easton Car & Construction Co., Easton, Pa.

EASTON

INDUSTRIAL CARS • TRAILERS • ELECTRIC LIFT TRUCKS

Hauck Mfg. Co.



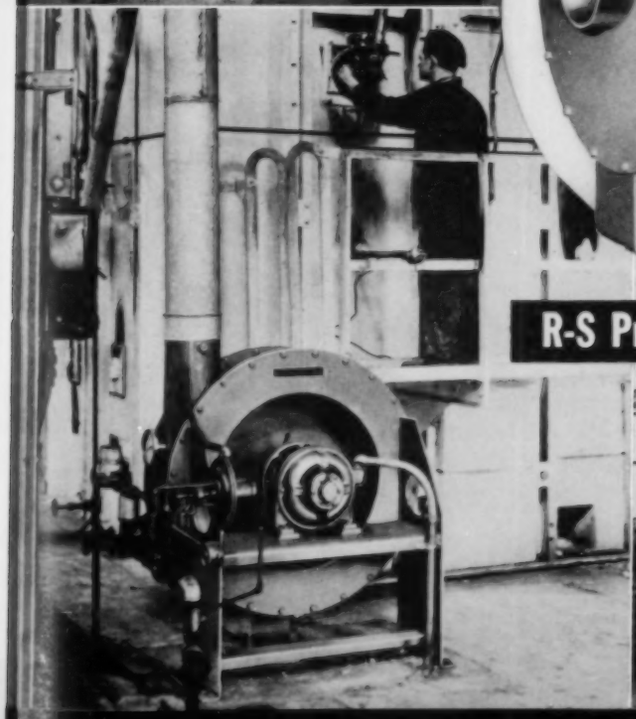
Surface Combustion Corp.

Specify TYPE "G" MOTORBLOWER FOR OIL and GAS FURNACES

Every Type "G" MOTORBLOWER shown on this page is playing a direct part in the nation's war effort—they are representative of the hundreds of similar units now in day-and-night service where oil- and gas-burning furnaces are used.

Ask your furnace or burner equipment maker to select the proper size Ingersoll-Rand Type "G" for your job. This will assure you of a dependable, economical blower for your combustion air supply.

Type "G" MOTORBLOWERS are built in sizes from 2 to 30 hp; pressures range from ½ to 2¼ lb; capacities from 100 to 4500 cfm. Bulletin 2671-A will be sent on request.



R-S Products Corp.

Atlanta Birmingham Boston Buffalo Butte Chicago Cincinnati Cleveland Dallas Denver Detroit Duluth El Paso Hartford Houston Kansas City Knoxville Los Angeles Newark New Orleans New York Philadelphia Picher Pittsburgh Pottsville Salt Lake City San Francisco Scranton Seattle St. Louis Tulsa Washington

Ingersoll-Rand

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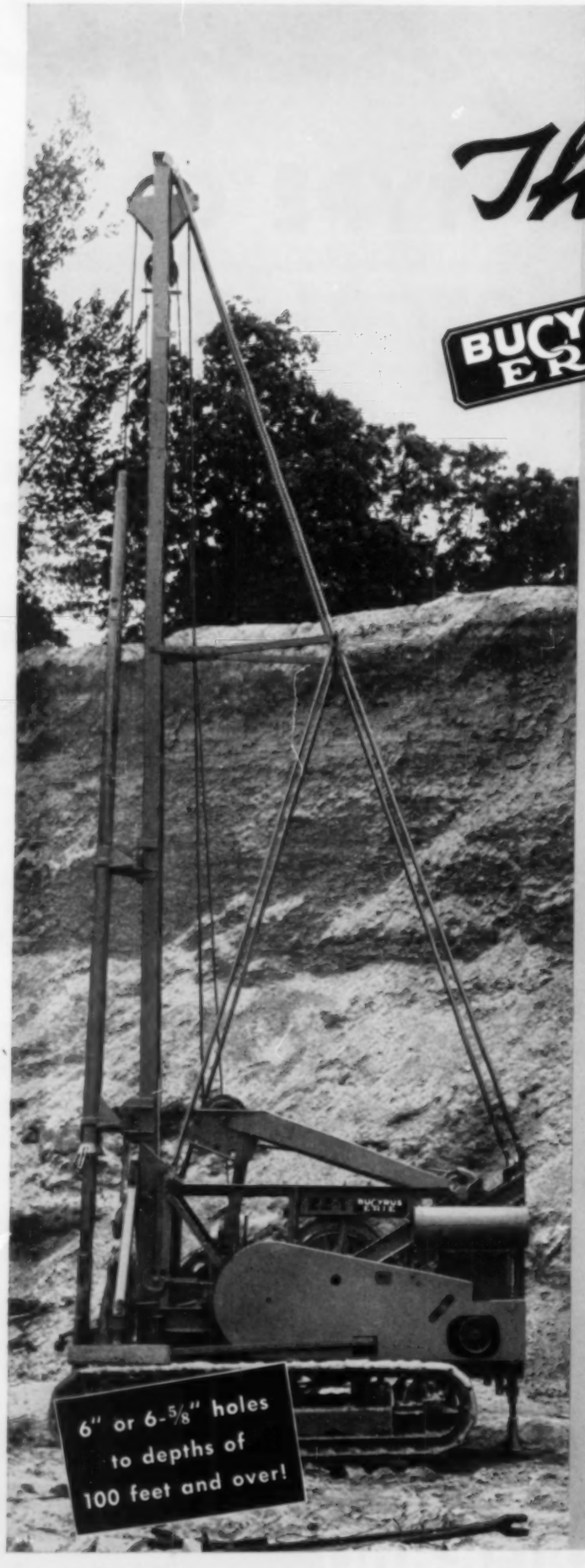


The NEW BUCYRUS ERIE 22-T

SELF-PROPELLING BLAST-HOLE DRILL WILL LOWER YOUR DRILLING COSTS

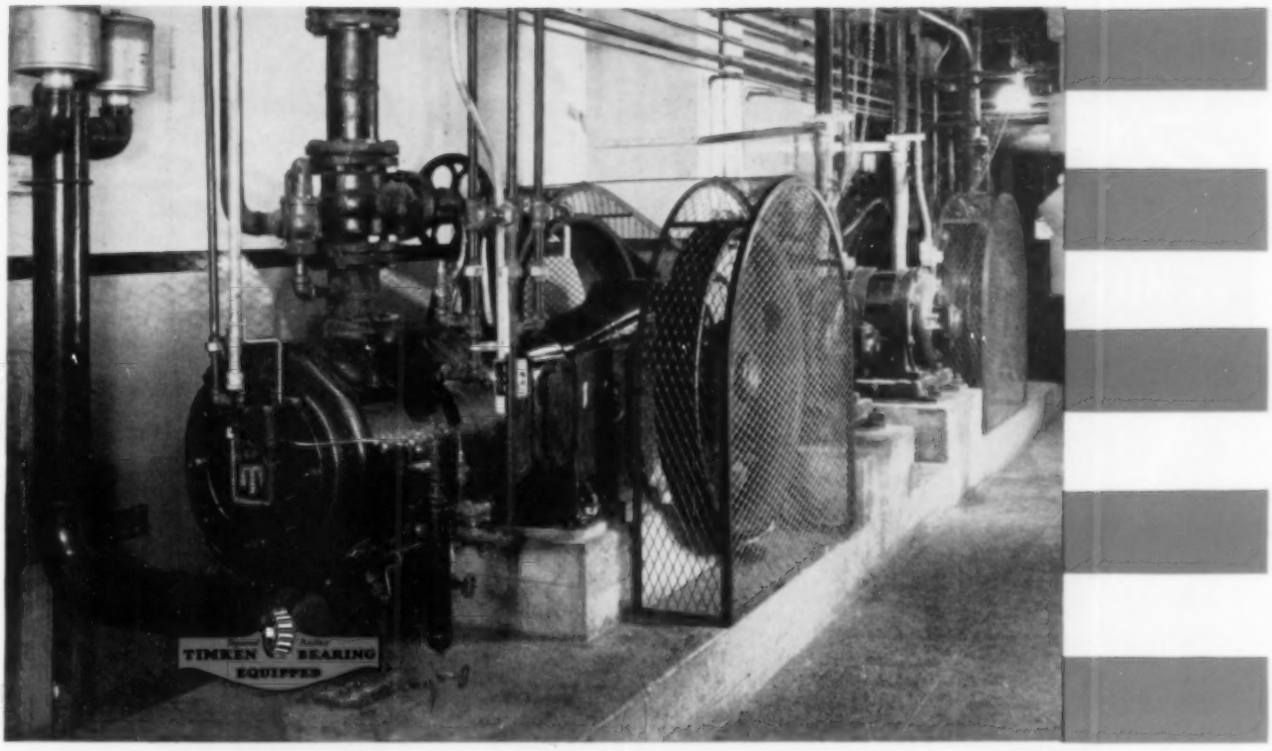
Designed to drill 6-in. or 6-5/8-in. holes to depths of 100 feet and over with utmost economy, this new Bucyrus-Erie 22-T gives you the shattering blows, high drilling speed, complete mobility, exceptional cable economy, and other cost-saving advantages of the larger modern blast-hole drills.

A few of its many modern features include: all-steel, all-electric-welded, box-type frame and spudding beam; all-steel, rigidly braced derrick; rubber shock absorber to give snap to line and protect machinery from vibration; wide, full-length crawler mounting with all-welded frame and pivoting axle for easy travel; and a choice of gasoline or electric power unit to suit conditions on your job.

These low-cost, modern 22-T's offer small or medium-sized quarries, cement plants, and contractors the same unexcelled performance that has made Bucyrus-Erie blast hole drills such popular machines in large quarries and mines all over the world.

BUCYRUS-ERIE CO.

SOUTH MILWAUKEE, WISCONSIN, U.S.A.



Ingersoll-Rand Type ES-NL Compressors equipped with Timken Bearings installed in a large public utility plant.

To assure maximum efficiency and endurance for the Victory drive, see that your anti-frictionized compressors are equipped with Timken Bearings.

Timken Tapered Roller Bearings are ideal for compressor service because of their multiple benefits. Crank shafts mounted on them receive triple protection, for Timken Bearings eliminate friction; carry radial, thrust and combined loads; and prevent misalignment.

Thus you not only get smooth-operating compressors, but compressors that stand up longer under constant hard use and require less maintenance.

The Timken Bearing Equipped compressors that you buy today will be capable of meeting every demand for air power (within their capacity) now and for years to come.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

HELP ASSURE VICTORY

Buy War Bonds. Conserve Rubber. Eliminate Unnecessary Travel. Use the Telephone Only When Important. Salvage All Scrap and Waste Material.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

STEEL-SAVING NAYLOR PIPE IS HELPING WIN THE WAR

- IT'S *light in weight*
- IT *saves steel*
- IT *speeds, simplifies installation*
- IT'S *leak-tight*
- IT *absorbs vibration*
- IT *saves money*

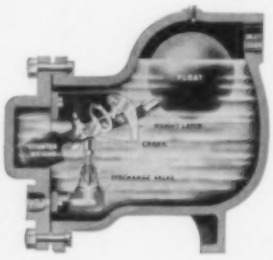
The advantages of Naylor Pipe in wartime are vitally important to you in peace time. Naylor is the pipe to remember when Victory is won.

Sizes from 4" to 30" in diameter with all types of fittings, connections and fabrication.

Write for Naylor Catalog

NAYLOR PIPE COMPANY
1245 EAST NINETY-SECOND STREET
CHICAGO, ILLINOIS

NAYLOR LOCKSEAM SPIRALWELD **PIPE**



Specially Designed for Automatic ***Drainage*** of water and oil from Air Tanks, Receivers, Aftercoolers, Separators, etc.

NICHOLSON "JR" MODEL COMPRESSED AIR TRAP

One body size—½", ¾" or 1" inlet—½" outlet. Pressures to 125 lbs. Other traps for pressures to 1500 lbs. Bulletin No. 941.

2-3 and 4-Way Flat Disc Type
AIR CONTROL VALVES

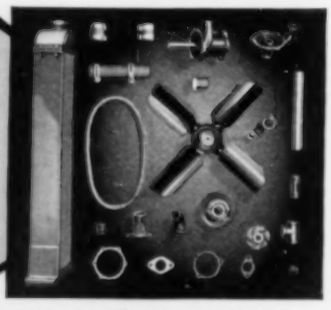
For single or double acting air, steam, water or oil cylinders, etc. Non-corrosive metals used in all vital parts. Sizes ¼" to 1½".

SEE OUR CATALOG IN SWEET'S

W. H. NICHOLSON & CO.
180 Oregon St.
Wilkes-Barre, Pa.

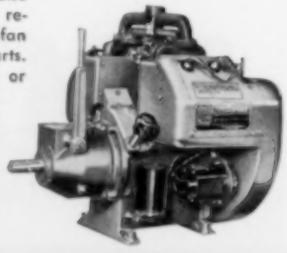
Air Separators, Steam Traps, Flexible Couplings, Expanding Mandrels, Steel and Stainless Steel Floats, etc.

Saved FOR WAR PRODUCTION



In the promotion of today's urgent war effort, manufacturers, sellers, and users of power-operated equipment (within a 1 to 35 hp. range) can effect substantial savings of critical materials, labor, and machine work at the manufacturing source by specifying WISCONSIN AIR-COOLED ENGINE POWER.

These heavy-duty engines require none of the 26 parts illustrated above, which comprise the cooling system of a typical water-cooled engine . . . parts that also require periodical servicing and replacement. One simple flywheel-fan casting replaces all of these parts. And there are no water chores or troubles to worry about.



Wisconsin Heavy-Duty Air-Cooled Engines are made in a complete range of types and sizes, 1 and 4 cyl., 1 to 35 hp. Illustrated is the VE-4 V-type 4-Cyl. Engine.

MOST POWER Per POUND

WISCONSIN MOTOR Corporation
MILWAUKEE, WISCONSIN, U. S. A.

World's Largest Builders of Heavy-Duty Air-Cooled Engines

Get in the SCRAP

The Maxim Silencer Company adds its appeal to that of your Government to **Get in the Scrap** . . . every last piece of unused metal in your plant, in your home, on your farm, to help make more **Steel** for **Victory.**

Maxim needs steel to make more Silencers for transports, the merchant marine and the fighting ships that convoy them. Maxim Spark Arrestor Silencers help save lives . . . save valuable cargoes.

Your scrap metal is important. **Will you get in the Scrap?**

THE MAXIM SILENCER CO.
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MAXIM

COMPRESSOR EQUIPMENT

STURDY • SOUNDLY DESIGNED

JARECKI VALVES

Sizes and types to meet every condition, each soundly built, perfectly threaded and individually tested.

ERIE UNLOADER

Maintains constant pressure by governing inlet of compressor. Loads and unloads without shock or strain.

ERIE GOVERNORS

For steam engines, pumps or compressors. For speed control only or for combined speed and pressure control.

JARECKI FITTINGS

Air-furnace malleable fittings . . . close-grained, cast iron fittings, all with perfect threads. A complete line.

JARECKI *Manufacturing Co.*
ERIE PENNSYLVANIA, U.S.A

"LOGAN"
AIR-DRAULIC CYLINDER

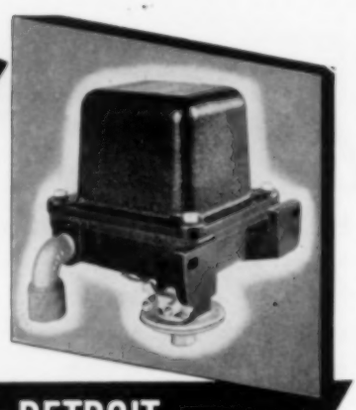
As Applied to

STANDARD No. 4 SHELL BANDER

The automatic feeding device on this Standard Shell Bander, manufactured by Standard Machinery Company, of Providence, R. I., is operated by a "LOGAN" Air-Draulic Cylinder. A "LOGAN" Air-Draulic Cylinder uses air pressure as a power means and oil as a regulating means, combining the speed of an air cylinder with the smooth, steady cushioning action of a hydraulic cylinder. A "LOGAN" Model "TL" Valve controls the action of the "LOGAN" Air-Draulic Cylinder. Let "LOGAN" Representatives and Engineers make recommendations on your problems, or write for "LOGAN" Air-Draulic Bulletin 470.

LOGANSPORT MACHINE, INCORPORATED
920 PAYSON ROAD LOGANSPORT, INDIANA
Manufacturers of Air and Hydraulic Devices, Chucks, Cylinders, Valves, Presses and Accessories

HERE IS AN *Explosion-Resisting* PRESSURE SWITCH



● The **CLASS 9013 TYPE AR** switch is built for use in Class I Group D hazardous locations. Top pressure 225 lbs.—standard air compressor settings—with or without release valve. Ratings are 2 H.P. 110 V., 3 H.P. 220 V. single phase and 5 H.P. 220-550 V. polyphase.

SWITCH • PROTECT • REGULATE • DO IT ALL WITH SQUARE D

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408 pages, 80 illustrations. Flexible, Morocco binding, gold-edged.

Compressed Air Data

A Handbook on Pneumatic Engineering and Related Subjects

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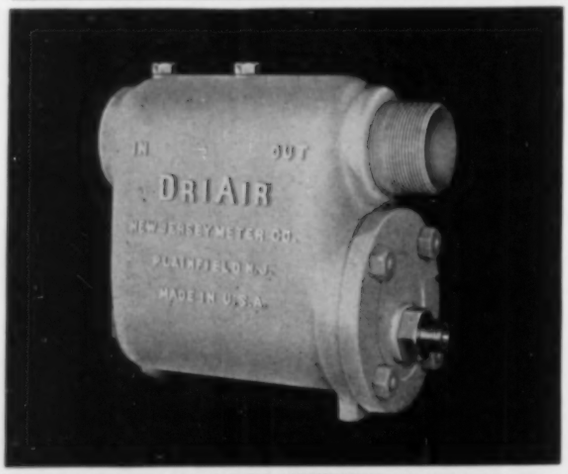
GREATER PNEUMATIC EFFICIENCY



DriAir may be suspended from overhead piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

SEPARATES • COLLECTS • DELIVERS

WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

● DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

Write for Bulletin DA which fully describes the construction and operation of the DriAir.

NEW JERSEY METER COMPANY
PLAINFIELD, NEW JERSEY

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.

R. C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET · ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

COOLANT PUMPS . .

I-R coolant pumps are ideal for handling coolant and cutting oils on grinders, cut-off machines, drills, lathes, automatics, etc. They are available in flange and immersion types for capacities from 2 to 150 gal per min. and heads to 130 ft.

9-175

Ingersoll-Rand
CAMERON PUMP DIVISION
11 BROADWAY, NEW YORK, N. Y.

Compressor Capacity S-T-R-A-I-N-E-D to the Limit?

NOPAK Leakproof Valves Can Give It a Lift!

Before you invest in an additional compressor, give your present equipment a chance to deliver its full rated capacity. How? *First*, replace all worn, leaky, air-wasting shut-off or operating valves with NOPAK Valves. *Second*, check air lines for leaks at all joints and unions. Remember, one tiny air leak can waste $20.00 to $28.00 worth of compressed air in a nonth!

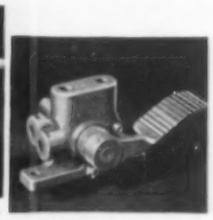
After taking these steps to halt pressure loss, you'll notice a substantial increase in compressor capacity plus a worthwhile saving in air costs. Yet, you gain these benefits at only a fraction of the cost of an extra compressor.

NOPAK Valves are wearproof, as well as leakproof, have no packing to deteriorate, require no packing replacement, save maintenance expense. What's more, we can ship illustrated types, in all sizes, immediately.

GALLAND-HENNING MANUFACTURING CO.
2759 South 31st Street • Milwaukee, Wisconsin

NOPAK Jolt-Squeeze Valve for Molding Machines.

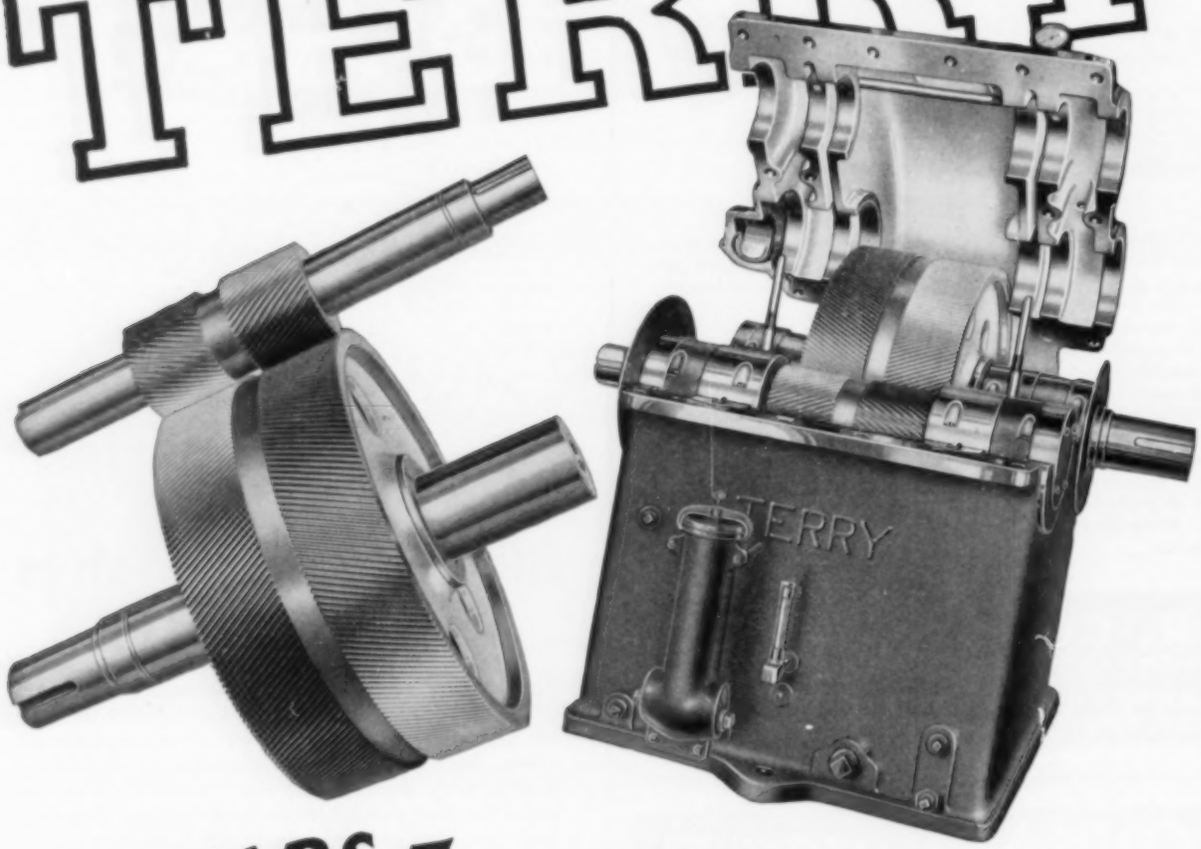
NOPAK Shut-Off Valve for Quick or Throttling Action.



NOPAK Type R Foot Operated 3- and 4-Way Control Valve.

NOPAK *Representatives in Principal Cities*
VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE

TERRY



GEARS — FOR SPEED INCREASING OR SPEED REDUCING

The Terry gear has been developed to handle the high speeds and powers that are associated with steam turbine installations. It has been used successfully in thousands of plants in connection with turbines, high speed centrifugal compressors and the like.

Each Terry gear is carefully engineered to suit the installation. All rotating parts are accurately balanced. Forced feed lubrication is used on the bearings and the meshing teeth. The teeth are double helical and are generated on precision gear cutting machines. The bearings are of the babbit lined sleeve type and are unusually heavy so as to prevent distortion under load.

Full details of the Terry gear are included in our bulletin S-130. A request on your business letterhead will bring a copy.

Above: Typical Terry high speed gear. Accurate fixtures and gauges insure that the boring of the case is in perfect alignment and that standard bearing shells will exactly fit and be interchangeable.

T-1148

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Edward Kraemer & Sons *report* . . .

"Our MOBIL-AIR is Saving 40% in Vital Gasoline

and at the same time our drills are doing more work"

Ingersoll-Rand MOBIL-AIR AIR POWER

(Top and Center) K-315 MOBIL-AIR operating two Jackhamers

(Bottom) Ingersoll-Rand portable Model 315

This well-known Wisconsin contractor continues, "During a 460-hour operating period we kept a close check on a K-315 MOBIL-AIR Compressor and a previous Ingersoll-Rand Model 315 Portable (in excellent condition). Both machines operated 55-lb Jackhamers drilling in medium-hard rock. The gasoline consu.nption was as follows:

Compressor Model	Jackhamers Operated	Hours Operated	Gasoline Consumed
K-315 MOBIL-AIR	2 3	300 160	1642 gal.
Previous Model 315	2	460	2355 gal.

Gasoline SAVED by MOBIL-AIR . . . 713 gallons

"Note that the MOBIL-AIR ran a third Jackhamer during 160 hours. If the Model 315 machine had also run this extra drill, it would have consumed about 2760 gallons instead of 2355. Expressed in terms of work done—Jackhamer-hours—the MOBIL-AIR used *40% less fuel.*

"In addition, our Jackhamers run by the MOBIL-AIR drilled faster than when run by the older portable because its DRILL-MORE Multi-speed Regulator maintained more uniform and higher average pressures."

No wonder Mr. Kraemer is so enthusiastic about MOBIL-AIR . . . his results proving two Ingersoll-Rand claims—gasoline savings up to 40% and faster drilling.

• • •

The patented DRILL-MORE Multi-Speed Regulator automatically selects the slowest and most efficient of three working speeds that will maintain the required air pressure. It saves fuel, not only because it eliminates most of the usual idling periods which waste gasoline, but because the average working speed of the compressor and engine is slower and more efficient. Wear and tear is reduced . . . the machine lasts longer. The DRILL-MORE Regulator maintains excellent pressure control for operating air tools.

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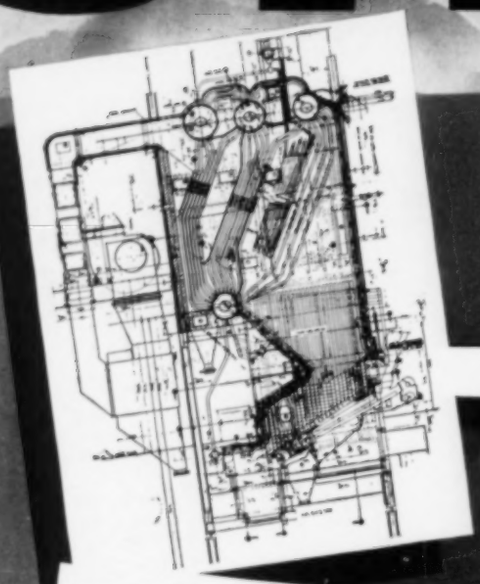
STEAM

for

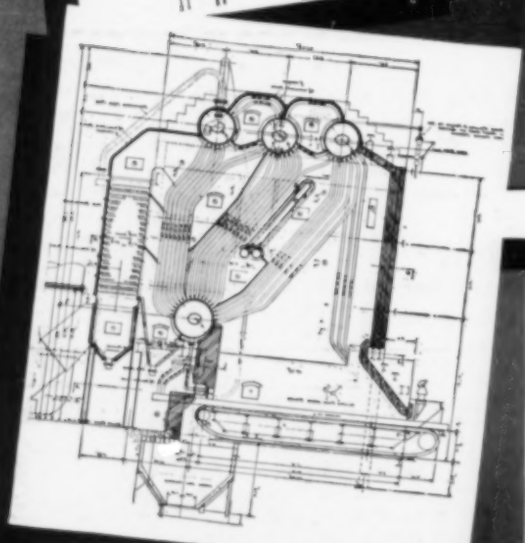


POWER

SOUTHERN COLORADO POWER COMPANY
Pueblo, Colo.

90,000 lbs. steam per hour Vogt LE type bent tube boiler with underfeed stoker. Water walls and economizer. Design pressure 525 lbs. Total steam temperature 750 degrees F.

•

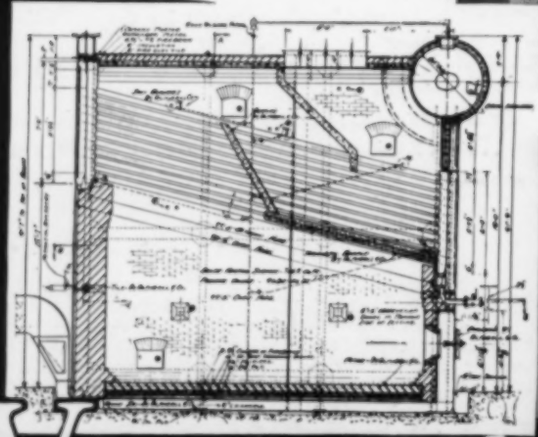


PROCESS

IN A LARGE MID-WESTERN STEEL MILL

Two 105,000 lbs. steam per hour Vogt LE type bent tube boilers with chain grate stokers and economizers. Design pressure 225 lbs. Total steam temperature 550 degrees F.

•



HEATING

CRIMINAL COURTS BUILDING AND JAIL
New York City

Four Vogt sectional header type boilers of 47,000 lbs. steam per hour capacity, oil fired. Design pressure 200 lbs.

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LOUISVILLE, KENTUCKY
Branch Offices: NEW YORK CLEVELAND
CHICAGO PHILADELPHIA DALLAS

Vogt *Water Tube* BOILERS

BENT TUBE AND SECTIONAL HEADER TYPES